INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

MODEL LM

FA PACKAGE

THIS MANUAL APPLIES TO UNITS

BEARING SERIAL NO. PREFIX A

MP MASTER
MA28780

LAMBDA

LAMBDA ELECTRONICS CORP.–MELVILLE, L. I., N. Y.

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This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics Corp.

LAMBDA ELECTRONICS CORP. MELVILLE, L.I., N.Y.

MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

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SPECIFICATIONS AND FEATURES

The following specifications apply for all Lambda FA package LM power supplies. Specification exceptions noted here relate to models incorporating model option "Y" and/or "T". Performance specifications do not change for models with suffix "R", e.g., LM-FA-4R unless the models also include model options "Y" and/or "T" e.g., LM-FA-4YR; for these models the appropriate specification exceptions also apply.

NOTE: Specifications in italics apply only for Lambda models with a "Y" suffix, e.g., LM-FA-4Y. AC INPUT specification with an asterisk*, applies only for Lambda models with a "V" or with a "T" suffix, e.g., LM-FA-4YT.

DC OUTPUT--Voltage regulated for line and load

Voltage Range....For voltage range see table I of pertinent model group.

Multi-Current Ratings....Current ratings specified for each maximum ambient temperature apply over entire output voltage range, with input frequency 55-65 cps. For input frequencies 45-55 at 105-132 VAC or 200-250 VAC, derate maximum current ratings 10% at all ambient temperatures; for frequencies 45-55 at 205-265 VAC, 40° current rating does not apply.

For input frequencies 360-440 cps, consult factory for current ratings.

For maximum current ratings at each ambient temperature see table I of pertinent model group.

REGULATED VOLTAGE OUTPUT

Regulation (line)...Less than 0.05 percent plus 4.0 millivolts for input variations from 105-132 or 132-105 volts AC

...Less than 0.01 percent plus 1.0 millivolt for input variations from 105-132 or 132-105 volts AC

Regulation (load)...Less than 0.03 percent plus 3.0 millivolts for load variations from 0 to full load or full load to 0

...Less than 0.02 percent plus 2.0 millivolts for load variations from 0 to full load or full load to 0

Remote Programming

External Resistor...Nominal 200 ohms/volt output

Programming Voltage...One-to-one voltage change

Ripple...One millivolt rms; 3 millivolts peak-to-peak with 45-65 cps input

... 0.5 millivolt rms; 3 millivolts peak-to-peak with 45-65 cps input

Temperature Coefficient...Change in output voltage less than 0.03%/°C

...Change in output voltage less than 0.01%/ C

AC INPUT--105-132 volts AC at 45-440 cps; 750 watts+

+ With output loaded to full 40°C rating and input voltage 132 volts at 55-65 cps.

*...200-250 volts AC at 45-440 cps ("T" option)

*...205-265 volts AC at 45-440 cps ("V" option)

INPUT FUSE--"SLO-BLO" fuse F1 protects the AC input circuit. Overload of the supply does not cause fuse failure.

OVERLOAD PROTECTION

Thermal....Thermostat resets automatically when overtemperature condition is eliminated

Electrical...Within rated voltage range, an automatic electronic current-limiting circuit limits output current to approximately 110 percent of 40°C rated current for protection of load and power supply; for overloads approaching short circuit, both voltage and current decrease until at short circuit, current is approximately 40 percent of the rated current.

OVERSHOOT--No overshoot of output voltage under conditions of power turn-on, power turn-off, or power failure.

INPUT AND OUTPUT CONNECTIONS--Heavy duty terminal block on rear of chassis

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE--Continuous duty from 0°C to 71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE-- -55°C to +85°C

METERS--Voltmeter and ammeter monitor the voltage and load output current respectively on metered (M) models.

CONTROLS

DC output control...VOLT ADJ. control on front panel of all units permits adjustment of DC output voltage.

Overvoltage Control...On units with overvoltage circuit, OV ADJ control permits setting of the overvoltage protection point.

Power...Panel-mounted magnetic circuit breaker on "OV" suffix models or power-on switch on all other models and indicator light. The circuit breaker or switch controls application of input power to the supply. Overvoltage condition causes the breaker to trip. When the breaker or switch is in the ON position the red ON indicator lamp glows.

REMOTE SENSING--Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

PHYSICAL DATA

Size. . . . . 3-15/32" H x 19" W x 16-1/2" D

Weight . . . . . 52 lbs. net; 62 lbs. shipping wt.

Panel Finish . . . Brushed aluminum clear anodized panels with grey inlay (Standard); special finishes available to customer's specifications at moderate surcharge.

MOUNTING--Standard 19" rack mounting.

MODEL OPTIONS

Suffix "T" Input Option...Standard LM power supplies are available for operation with 200-250 volt, 45-440 cps input.

Suffix "Y" High Performance Option...All Lambda LM power supplies are available with high performance specifications. See italicized entries under SPECIFICATIONS AND FEATURES.

Suffix "R" Fungus Proofing Option...Standard LM power supplies can be obtained with fungus proofing treatment with MIL V 173 varnish for all fungi nutrient components.

Suffix "M" Meter Option...All Lambda LM power supplies are available with voltmeter and ammeter.

Suffix "OV" Overvoltage Protection Option...LM-FA power supplies are available with a built-in overvoltage protection circuit which prevents damage to the load that can be caused by excessive power supply output voltage.

Suffix "V" Input Option...Standard LM power supplies are available for operation with 205-265 volt, 45-440 cps input.

THEORY OF OPERATION

GENERAL

The Lambda power supply consists of an AC input circuit and transformer; a bias supply consisting of an auxiliary rectifier, filter, and a zener diode regulator; and a main regulator circuit consisting of the main rectifier and filter, a series regulator, emitter follower drivers, an error amplifier, a current limit amplifier, an output voltage sensing circuit and an output current sensing resistor.

The circuit arrangement is shown in block diagram form in figure 7. The circuitry is discussed with reference to the block diagram and the schematic diagram.

FUNCTIONAL DESCRIPTION

Single phase input power is applied to transformer T1 through the input circuit containing thermostat S1, which protects the supply against overheating.

The main rectifier, a full-wave rectifier, provides the power which is filtered and then regulated via a series regulator and delivered to the output. Bias supply, half-wave, auxiliary rectifier CR7, provides voltage filtered by capacitor C7 and regulated by zener diode CR6 for current limit amplifier Q3 and error amplifier Ql, Q2. Zener diode CR1 and resistor R5, across the bias supply, provide a regulated temperature compensated reference voltage. Resistor R4 compensates for input voltage variations.

Operation of the voltage regulator circuit is determined by changes in the output voltage. A change in the output voltage is sensed by the sensing divider resistors which compare output voltage with the +S reference voltage. This provides an error voltage at junction of R2 and R3 which is amplified by error amplifier Q1, and Q2 and is current amplified by drivers Q5, Q6 (and as applicable Q8, Q9). The amplified signal from the drivers controls the voltage across the series regulator transistors, which function as the active regulating element, restoring output voltage to the proper level.

Current limit circuit operation is determined by changes in the load. Current limit amplifier Q3 samples load current through current sensing resistor R25A. When the voltage drop across R25A increases compared with the preset voltage reference determined by R17 and R18, Q3 conducts. Thus, when the output current rating of the unit is exceeded, current limit amplifier Q3 conducts decreasing the current through drivers Q5, Q6 (and, as applicable Q8, Q9), resulting in an increase of voltage across the series regulator and a decrease of the output voltage, effectively limiting the output current to a safe value. The current limit value is determined by the factory setting of current limit potentiometer R17.

When operating conditions approach short circuit, the output voltage decreases. Since the voltage determined by R17 and R18 is proportional to the output voltage, when the output voltage decreases, Q3 is biased into turn-on at lower and lower load currents until output voltage decreases to zero and current decreases to a predetermined low value.

OVERVOLTAGE PROTECTOR CIRCUIT, FUNCTIONAL DESCRIPTION

Divider network OV-R1, OV-R2, OV-R3, OV-R4 and OV-R7 attenuates the power supply output voltage. When the power supply output voltage increases above the overvoltage limit set by OV ADJ control OV-R1, the attenuated voltage of the divider network also increases, biasing transistor OV-Q1 on. OV-Q1, in turn, biases OV-Q2 on through resistor OV-R10. OV-Q2 supplies gate current to OV-SCR-1, turning it on, driving current through the breaker trip coil and into the gate of SCR-71, turning SCR-71 on. This, in turn, causes the voltage at the power supply terminals to drop, protecting the load from excessive supply output voltage. OV-SCR-1 and SCR-71 conduct until the circuit breaker trips, causing power to the power supply to be cut off.

CAUTION

The overvoltage protector will <u>not</u> provide protection against overvoltage conditions caused by storage batteries or other power sources used in conjunction with the Lambda power supply. Whenever additional power sources must be used with the Lambda power supply and overvoltage protector combination, consult the factory for proper installation information.

OPERATING INSTRUCTIONS

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature. When load current exceeds 110% of 40°C rating, both voltage and current decrease until voltage reaches zero and the current at short circuit equals approximately 40 percent of the rated current.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying AC input power.

Ground Connections. The Lambda power supply can be operated either with negative or positive output terminal grounded. Both positive and negative ground connections are shown in the diagrams for all suggested output connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminal block on the rear of the supply. Apply input power to terminals 1 and 2; always connect the ungrounded (hot) lead to terminal 1.

The supply positive terminal is brought out to terminal 6; the negative terminal to terminal 4.

NOTE: When shipped from the factory, the supply is ready for use as a local-sensing constant voltage source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram.

Supply-Load Connections. The regulation of the supply at the load may change when connecting leads of practical length are used. To minimize the effect of the output load leads, remote sensing is used. Refer to figure 1 to determine voltage drop for particular cable lengths, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local-Sensing Connection, See Figure 3.

Remote-Sensing Connection, See Figure 4.

NOTE: Whenever the supply is connected for remote sensing, the total voltage drop across both load leads must not exceed the 5 percent output voltage band width of the power supply.

Programmed Voltage Connection Using External Resistor, See Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at nominal 200 ohms/volt output and a shorting-type switch. For continuous voltage variations, use a variable resistor with the same ohms/volt ratio in place of the voltage divider and shorting-type switch. Use low temperature coefficient resistor(s) to assure most stable operation.

Programmed Voltage Connection Using Programming Voltage, See Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage of the programmed supply will maintain a one-to-one ratio with the programming supply.

The programming supply must have a reverse current capability of 6 ma. minimum.

Alternatively, when supplies with less than 6 ma. reverse current capability are used, a resistor capable of drawing 6 ma. at the minimum programming voltage must be connected across the output terminals of the supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown

The thermostat opens the input circuit only when the power supply output current exceeds the current rating specified for the operating ambient temperature, causing the temperature of the transistor heat radiator to exceed a maximum safe value. The thermostat will automatically reset when the temperature of the radiator decreases to safe operating value. After eliminating the cause(s) for overheating and allowing time for the power supply to cool to a proper temperature, resume operation of the supply.

Fuse Shutdown

Internal component failure is prevented by a fuse which protects components from damage caused by excessive currents. The fuse will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of the fuse can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative.

Circuit-Breaker Shutdown (For "OV" Suffix Models Only)

The ON-OFF circuit breaker controls application of input power to all Model LM-FA power supplies with built in overvoltage protection. When the power supply output voltage increases above the preset overvoltage limit, the breaker trips, opening the input circuit, causing the ON-OFF indicator to extinguish. After eliminating the cause(s) for overvoltage, resume operation of the supply.

MAINTENANCE

GENERAL

This section describes trouble analysis routine, calibration and test procedures that are useful for servicing the Lambda power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on specifications and features for the minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit elements, and external wiring for malfunction before trouble shooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumpers and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 7, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal no load operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an in-circuit transistor checker. If no checker is available, transistors can be checked with an ohmmeter that has a highly limited current capability. Observe proper polarity for PNP or NPN to avoid error in measurement. The forward transistor resistance is low but never ZERO; backward resistance is always higher than the forward resistance.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional faulty components could damage the replaced component.

When soldering semi-conductor devices, hold the lead being soldered with a pair of pliers or a commercial heat sink device placed between the component and solder joint.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact but not covered with solder it is a good contact. Do not attempt to cover with solder.

2. Voltage measurements can be made from either side of the board. Use a needle-point probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to measuring instrument.

3. Always use a heat sink when soldering transistors; a transistor pad with mounting feet is an effective heat sink.

4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

5. When unsoldering components from the board never pry or force loose the part, unsolder the component by using the wicking process described below:

   (a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

   (b) Dip the wick in liquid rosin flux.

(c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

(d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes, and is used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:

(a) AC power of proper voltage and frequency is present at input terminals.

(b) Either positive or negative terminal is connected to chassis ground.

(c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

TROUBLE CHART

Symptom	Probable Cause	Remedy
1. No output voltage	No power input, thermostat S1 open	Check power source, S1, line cord and line cord plug; shut off unit, allow to cool and check ambient temperature
	Improper output terminal connection	Refer to appropriate connection diagram, and check for correct connections
	Faulty Q2, Q3, CR1, CR6	Check Q2, Q3, CR1, CR6 for short and replace as required
2. Unable to adjust output voltage	Damaged VOLTAGE ADJUST control	Check R1 for shorts and/or open: replace as required
	Supply operating as constant current source at current limit value	Remove load, check load value and check for shorts and/or improper supply-load connections; refer to appropriate diagram for correct connections
3. Output voltage too high	Improper output terminal connection	Refer to appropriate connection diagram, and check for correct connections
On OV units, breaker trips and cannot be reset	Improper adjustment of OV ADJ control	Refer to procedure for adjusting OV ADJ control and reset control
	Faulty Q1, R1, Q10-Q18, Q5, Q6 (and Q8, Q9 as applicable) or CR1	Check R1 for open; Q10-Q18, Q5, Q6, (Q8, Q9), Q1 for short; CR1 for open and replace as required
	OV-Q1, OV-Q2, OV-SCR 1 on OV subassembly faulty (least probable fault cause)	Check OV-Q1, OV-Q2, OV-SCR 1 for short and replace as required
4. Output voltage too low	Load resistance improper for unit ratings	Check load resistance value
	Faulty Q2, Q3, R25A, R17	Check Q2, Q3 for short, R25A, R17 for open, replace as required

TROUBLE CHART (Cont'd)

Symptom	Probable Cause	Remedy
4. (Cont'd)		
Output voltage too low on units with OV option	Faulty SCR 71 in OV circuit (least probable fault cause)	Remove cathode connection to SCR 71 and reapply power, if output is restored SCR 71 is faulty; replace SCR 71
5. High ripple and unregulated DC output	Load resistance improper for unit ratings	Check load resistance value
6. High ripple	Improper ground	Connect terminal 6 or terminal 4 to ground terminal 5

PERFORMANCE CHECK

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 8. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC VTVM (John Fluke Model 825A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the full load to no-load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-132 or 132-105 volts AC and check the power supply line regulation accuracy on the VTVM differential meter.

Use a VTVM, Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

ADJUSTMENT OF CALIBRATION CONTROL R17

The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C and has not been operated with load for at least one hour.

Whenever Q3, R25A or R17 are replaced, and voltage and current indications do not reflect maximum ratings, adjust R17 as follows:

1. Remove AC power input to the supply.
2. Unsolder wiper of R17 from resistor housing and turn to full CW position.
3. Operate power supply for constant voltage with local sensing, connected as shown in figure 3, with no external load.
4. Turn VOLT ADJ control until minimum rated output voltage is obtained.
5. Apply load so that output current is 110% of 40°C rating for the unit.
6. Using an oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R17 in a CCW direction. Adjust R17 until output ripple increases sharply and oscilloscope pattern changes.
7. After adjustment is completed, remove AC power input to the supply and solder wiper of R17 to resistor housing.
8. After soldering, check setting and repeat adjustment procedure if required.

ADJUSTMENT OF OV ADJ CONTROL OV-R1

Adjust the voltage-protection point of overvoltage protector circuit as follows:

1. Turn OV ADJ control on front panel fully clockwise.
2. The recommended voltage-protection point is 115% of normal power supply operating voltage plus one volt. Compute this value for the operation voltage being used.

3. Turn on the power supply, and raise the output voltage to the desired voltage-protection point; monitor the power supply output voltage to assure correct voltage. If the power supply does not have an adequate adjustment range omit steps 4 and 5, and continue with step 6 below.

4. Slowly turn the OV ADJ control counterclockwise until the circuit breaker trips, indicating that the voltage protection point is reached.

5. The voltage-protection point is now set. Reduce power supply output voltage setting before re-applying input power.

6. If the power supply output voltage adjustment range does not extend to the protection-point voltage computed in step 2, proceed as follows:

   a) Turn on power supply and raise output voltage to the normal operating voltage.

   b) Slowly turn the OV ADJ control counterclockwise until the circuit breaker trips.

   c) Refer to chart below, select appropriate volts/turn ratio, and turn OV ADJ control clockwise by the number of turns equivalent to 1 volt plus 15% of the operating voltage.

MODEL	VOLTS/TURN	OVERVOLTAGE ADJUSTMENT RANGE
LM-FA3, FA3P3, FA3P6, FA4, FA4P5, FA5, FA6	0.3	3 - 8v
LM-FA8, FA10, FA12, FA15	0.8	6 - 20v
LM-FA18, FA20, FA24, FA28, FA36, FA48, FA60	2.7	18 - 79v

For Example:

When using power supply LM-FA5-OV with output voltage setting of 5 volts, calculate as follows:

$$T = \frac{1 + .15\ (OV)}{V/T}$$

where

T = turns of OV ADJ control

OV = operating voltage of power supply

V/T = volts/turn ratio from chart

$$T = \frac{1 + .15(5)}{0.3} = 5.8$$

Rotate OV ADJ control 5.8 turns in clockwise direction to obtain a voltage setting 1.8 volts above the 5-volt power supply setting, or 6.8 volts.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest office of the Lambda Electronics Corp. where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.
2. Lambda part number.
3. Description of part together with circuit designation.
4. If part is not an electronic part, or is not listed, provide a description, function, and location of the part.

PARTS LIST

The electrical parts located on all LM-FA models are listed here. Parts common to a group of LM-FA models are listed first. Unique parts of individual models within the group are listed separately, by model, immediately following the group common-parts listing. In addition there are separate listings of parts for the metered panel (M) option, the Y option and the overvoltage protection (OV) option, as applicable, for all LM-FA models. The parts listed for model LM-FA60 do not utilize the common parts-unique parts listings; all the parts for this model are sequentially listed under the applicable heading "PARTS FOR MODEL LM-FA60. Parts for the T option, V option and R option are included at the end of this listing.

MODELS LM-FA3—LM-FA5

COMMON PARTS

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
C1	Cap., mylar, 0.033 mfd ±10%, 400 vdc	CGL-33-009	$ .38
C2	Cap., mylar, 0.22 mfd ±10%, 80 vdc	CGM-22-004	.90
C3	Cap., elect., 25,000 mfd -10% + 100%, 20 vdc	CBT-25-011	12.28
C4	Cap., elect., 3.0 -10 + 75%, 100 vdc	CBN-30-015	1.58
C5	Cap., mylar, 0.018 mfd ±10%, 200 vdc	CGL-18-005	.24
C6	Same as C5		
C7*	Cap., elect., 140 mfd -10 + 100%, 30 vdc	CBR-14-030	2.25
C8	Not assigned		
C9	Cap., paper, 1.0 mfd ±20%, 200 vdc	CAN-10-024	1.90
C10	Same as C9		
C11 thru C17	Not assigned		
C18-C19	Same as C3		
C20 thru C29	Not assigned		
C30	Cap., mylar, 0.022 mfd ±10%, 200 vdc	CGL-22-001	.39
C31	Same as C4		
CR1*	Rectifier, zener diode	FBM-Z104	4.35
CR2	Rectifier	FBL-00-030	1.40
CR3	Same as CR2		
CR4, CR5	Not assigned		
CR6	Rectifier, zener diode	FBM-Z103	4.87
CR7	Same as CR2		
CR8	Rectifier	FBL-00-055	2.00
CR9	Not assigned		
CR10	Same as CR8		
DS1	Lamp assembly	HRD-00-009	3.10
Q1	Transistor, NPN	FBN-L110	3.25
Q2, Q3	Same as Q1		
Q4	Not assigned		
Q5	Transistor, NPN	FBN-L108	2.52
Q6	Transistor, NPN	FBN-36485	4.13

MODELS LM-FA3—LM-FA5 (Cont)

COMMON PARTS (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
Q7-Q9	Not assigned		$
Q10 thru Q18	Transistor, NPN	FBN-36972	6.50
R3	Res., ww, 1,200 ohms ±3%, 2 w	DFS-12-030	.90
R4*	Res., film, 15,000 ohms ±2%, 1/2 w	DCT-15-013	.30
R5	Res., film, 220 ohms ±2%, 1/2 w	DCR-22-005	.30
R6	Res., comp., 180,000 ohms ±10%, 1/2 w	DEB-1841	.12
R7	Res., film, 3,900 ohms ±5%, 1/2 w	DCS-39-014	.25
R8	Res., comp., 4,700 ohms ±10%, 1/2 w	DEB-4721	.12
R9	Res., comp., 150 ohms ±10%, 1/2 w	DCB-1511	.10
R10	Res., comp., 2,200 ohms ±10%, 1/2 w	DEB-2221	.12
R11	Res., comp., 22,000 ohms ±10%, 1/2 w	DEB-2231	.12
R12	Res., comp., 47 ohms ±10%, 1/2 w	DEB-4701	.12
R13*	Res., ww, 600 ohms ±3%, 3 w	DFR-60-005	.89
R14, R15	Not assigned		
R16	Res., comp., 560 ohms ±10%, 1/2 w	DEB-5611	.12
R17	Res., var., ww, 1,200 ohms ±10%, 1-1/2 w	DNS-12-026	1.25
R19-R21	Not assigned		
R22	Res., comp., 150 ohms ±10%, 1/2 w	DEB-1511	.12
R23	Res., comp., 15 ohms ±10%, 1/2 w	DEB-1501	.12
R24	Res., film, 68 ohms ±10%, 2 w	DCP-68-004	.15
R25A, B thru R29A, B	Res., tapped, two sections, 0.18 ohms ± 5%/section, 11w/section	DFM-36-049	1.60

MODELS LM-FA3—LM-FA5 (Cont)

COMMON PARTS (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
R30 thru R39	Not assigned		$
R40	Res., comp., 470 ohms ±10%, 2 w	DHB-4711	.15
R41+	Res., meter shunt, 50 amperes	ESP-50-002	2.50
S1	Thermostat	FKA-124-013	5.00
S2**	Switch, toggle, DPST	FDA-21-018	1.80
XF1	Fuseholder	HRM-00-002	.20

+This part only used on units with "M" meter option
*This part not used on units with "Y" option
**This part not used on units with "OV" option

UNIQUE PARTS

MODEL LM-FA3

F1	Fuse, "SLO-BLO", 3 AG, 10 amp	FFC-10-000	.21
M1*	Meter, volts, D-C, 0-8 vdc full scale	EBN-80-005	12.00
M2*	Meter, ampere, D-C, 0-50 amp. movement	EDP-50-017	18.00
R1	Res., var., w w, 300 ohms ±5%, 5 w	DNR-30-018	1.95
R2	Res., ww, 430 ohms ±3%, 3 w	DFR-43-058	.50
R18	Not assigned		
T1	Transformer	ABA-FA4	101.50

*This part only used on units with "M" meter option

MODEL LM-FA3P3

F1	Fuse, "Slo-Blo, 3 AG, 10 amp.	FFC-10-000	.21
M1*	Meter, volts, D-C, 0-5 vdc full scale	EBN-50-003	14.40
M2*	Meter, ampere, D-C, 0-50 amp. movement	EDP-50-017	18.00
R1	Res., var., w w, 600 ohms ±5%, 5 w	DNR-60-019 or DNR-60-026	2.25 2.50
R2	Res., ww, 430 ohms ±3%, 3 w	DFR-43-058	.50
R18	Not assigned		
T1	Transformer	ABA-FA4	101.50

*This part only used on units with "M" meter option

MODEL LM-FA3P6

F1	Fuse, "Slo-Blo", 3 AG, 10 amp.	FFC-10-000	.21
M1*	Meter, volts, D-C, 0-5 vdc full scale	EBN-50-003	14.40
M2*	Meter, ampere, D-C, 0-50 amp. movement	EDP-50-017	18.00
R1	Res., var., w w, 600 ohms ±5%, 5 w	DNR-60-019 or DNR-60-026	2.25 2.50
R2	Res., ww, 430 ohms ±3%, 3 w	DFR-43-058	.50
R18	Not assigned		
T1	Transformer	ABA-FA4	101.50

*This part only used on units with "M" meter option

UNIQUE PARTS (Cont)

MODEL LM-FA4

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
F1	Fuse, "Slo-Blo", 3 AG, 10 amp.	FFC-10-000	$ .21
M1*	Meter, volts, D-C, 0-5 vdc full scale	EBN-50-003	14.40
M2*	Meter, ampere, D-C, 0-50 amp. movement	EDP-50-017	18.00
R1	Res., var., w w, 600 ohms ±5%, 5 w	DNR-60-019 or DNR-60-026	2.25 2.50
R2	Res., ww, 600 ohms ±3%, 3 w	DFR-60-005	.89
R18	Not assigned		
T1	Transformer	ABA-FA4	101.50

*This part only used on units with "M" meter option

MODEL LM-FA4P5

F1	Fuse, "Slo-Blo", 3 AG, 15 amp.	FFC-15-000	.18
M1*	Meter, volts, D-C, 0-5 vdc full scale	EBN-50-003	14.40
M2*	Meter, ampere, D-C, 0-50 amp. movement	EDP-50-017	18.00
R1	Res., var., w w, 600 ohms ±5%, 5 w	DNR-60-019 or DNR-60-026	2.25 2.50
R2	Res., ww, 650 ohms ±3%, 3 w	DFR-65-062	1.00
R18	Res., film, 390 ohms ±5%, 1/2 w	DCR-39-004	.20
T1	Transformer	ABA-F07	101.50

*This part only used on units with "M" meter option

MODEL LM-FA5

F1	Fuse, "Slo-Blo", 3 AG, 15 amp.	FFC-15-000	.18
M1*	Meter, volts, D-C, 0-8 vdc full scale	EBN-80-005	12.00
M2*	Meter, amperes, D-C, 0-50 amp. movement	EDP-50-017	18.00
R1	Res., var., w w, 600 ohms ±5%, 5 w	DNR-60-019 or DNR-60-026	2.25 2.50
R2	Res., ww, 650 ohms ±3%, 3 w	DFR-65-062	1.00
R18	Res., film, 1300 ohms ±5%, 1/2 w	DCS-13-010	.25
T1	Transformer	ABA-F07	101.50

*This part only used on units with "M" meter option

MODELS LM-FA6 — LM-FA48

COMMON PARTS

C1	Cap., mylar, 0.033 mfd ±10%, 400 vdc	CGL-33-009	.38
C2	Cap., mylar, 0.22 mfd ±10%, 80 vdc	CGM-22-004	.90
C4	Cap., elect., 3.0 mfd -10% + 75%, 100 vdc	CBN-30-015	1.58
C5	Cap., mylar, 0.018 mfd, ±10%, 200 vdc	CGL-18-005	.24
C6	Same as C5		
C7**	Cap., elect., 140 mfd -10% + 100%, 30 vdc	CBR-14-030	2.25

COMMON PARTS (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
C8 thru C17	Not assigned		$
C20 thru C25	Not assigned		
C30	Cap., mylar, 0.022 mfd ±10%, 200 vdc	CGL-22-001	.39
C31	Same as C4		
CR1**	Rectifier, zener diode	FBM-Z104	4.35
CR2	Rectifier	FBL-00-030	1.40
CR3	Same as CR2		
CR4, CR5	Not assigned		
CR6	Rectifier, zener diode	FBM-Z103	4.87
CR7	Same as CR2		
CR8 thru CR11	Rectifier	FBL-00-057	2.25
DS1	Lamp assembly	HRD-00-009	3.10
F1	Fuse, "Slo-Blo", 3 AG, 15 amp	FFC-15-000	.18
Q1	Transistor, NPN	FBN-L110	3.25
Q2, Q3	Same as Q1		
Q4	Not assigned		
Q5	Transistor, NPN	FBN-L108	2.52
Q7 thru Q9	Not assigned		
Q11	Not assigned		
Q17	Not assigned		
R3	Res., ww, 1,200 ohms ±3%, 2 w	DFS-12-030	.90
R4**	Res., film, 15,000 ohms ±2%, 1/2 w	DCT-15-013	.30
R5	Res., film, 220 ohms ±2%, 1/2 w	DCR-22-005	.30
R6	Res., comp., 180,000 ohms ±10%, 1/2 w	DEB-1841	.12
R7	Res., film, 3,900 ohms ±5%, 1/2 w	DCS-39-014	.25
R8	Res., comp., 4,700 ohms ±10%, 1/2 w	DEB-4721	.12
R9	Res., comp., 150 ohms ±10%, 1/4 w	DCB-1511	.10
R10	Res., comp., 2,200 ohms ±10%, 1/2 w	DEB-2221	.12
R11	Res., comp., 22,000 ohms ±10%, 1/2 w	DEB-2231	.12
R12	Res., comp., 47 ohms ±10%, 1/2 w	DEB-4701	.12
R13**	Res., ww, 600 ohms ±3%, 3 w	DFR-60-005	.89
R14, R15	Not assigned		
R16	Res., comp., 560 ohms ±10%, 1/2 w	DEB-5611	.12
R17	Res., var., ww, 1,200 ohms ±10%, 1-1/2 w	DNS-12-026	1.25
R19 thru R21	Not assigned		
R22	Res., comp., 150 ohms ±10%, 1/2 w	DEB-1511	.12
R23	Res., comp., 15 ohms ±10%, 1/2 w	DEB-1501	.12
R30 thru R39	Not assigned		
S1	Thermostat	FKA-124-013	5.00
S2+	Switch, toggle, DPST	FDA-21-018	$ 1.80
XF1	Fuseholder, clip type	HRM-00-002	.20

**This part not used on units with "Y" option
+This part not used on units with OV option

UNIQUE PARTS

MODEL LM-FA6

C3	Cap., elect., 25,000 mfd -10 +100%, 20 vdc	CBT-25-011	12.28
C18, C19	Same as C3		
C26 thru C29	Cap., paper, 1.0 mfd ±20%, 200 vdc	CAN-10-024	1.90
M1*	Meter, volts, D-C, 0-8 vdc full scale	EBN-80-005	12.00
M2*	Meter, amperes, D-C, 0-50 ampere movement	EDP-50-017	18.00
Q6	Transistor, NPN	FBN-36485	4.13
Q10 thru Q12	Transistor, NPN	FBN-36972	6.50
R1	Res., var., ww, 600 ohms ±5%, 5 w	DNR-60-019 or DNR-60-026	2.25 2.50
R2	Res., ww, 800 ohms ±3%, 3 w	DFR-80-037	.84
R18	Res., film, 1300 ohms ±5%, 1/2 w	DCS-13-010	.25
R24	Res., film, 180 ohms ±10%, 2 w	DCR-18-012	.20
R25A, B thru R29A, B	Res., tapped, two sections, 0.18 ohms ±5%/section 11 w/section	DFM-36-049	1.60
R40	Res., comp., 470 ohms ±10%, 2 w	DHB-4711	.15
R41*	Res., meter shunt, 50 amperes	ESP-50-002	2.50
T1	Transformer	ABA-FA6	101.50

* This part only used on units with "M" meter option

MODEL LM-FA8

C3	Cap., elect., 25,000 mfd -10 + 100%, 20 vdc	CBT-25-011	12.28
C18, C19	Same as C3		
C26 thru C29	Cap., paper, 1.0 mfd ±20%, 200 vdc	CAN-10-024	1.90
M1*	Meter, volts, D-C, 0-10 vdc full scale	EBP-10-016	18.00
M2*	Meter, amperes, D-C, 0-30 amp. movement	EDP-30-016	18.00
Q6	Transistor, NPN	FBN-36485	4.13
Q10 thru Q18	Transistor, NPN	FBN-36972	6.50
R1	Res., var., ww, 1000 ohms ±5%, 5 w	DNS-10-032	1.95
R2	Res., ww, 1200 ohms ±3%, 2 w	DFS-12-030	.90

UNIQUE PARTS (Cont)

MODEL LM-FA8 (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
R18	Res., film, 2400 ohms ±5%, 1/2 w	DCS-24-001	$ .25
R24	Res., film, 180 ohms ±10%, 2 w	DCR-18-012	.20
R25A, B thru R29A, B	Res., tapped, two sections, 0.30 ohms ±5%/section, 11 w/section	DFM-60-050	1.45
R40	Res., comp., 470 ohms ±10%, 2 w	DHB-4711	.15
R41*	Res., meter shunt, 30 amperes	ESP-30-001	2.50
T1	Transformer	ABA-FA8	101.50

*This part only used on units with "M" meter option

MODEL LM-FA10

C3	Cap., elect., 14,000 mfd -10 + 100%, 35 vdc	CBT-14-012	12.28
C18, C19	Same as C3		
C26 thru C29	Cap., paper, 1.0 mfd ±20%, 200 vdc	CAN-10-024	1.90
M1*	Meter, volts, D-C, 0-15 vdc full scale	EBP-15-017	18.00
M2*	Meter, amperes, D-C, 0-30 amp. movement	EDP-30-016	18.00
Q6	Transistor, NPN	FBN-36485	4.13
Q10 thru Q18	Transistor, NPN	FBN-36972	6.50
R1	Res., var., ww, 2,200 ohms ±5%, 5 w	DNS-22-023 or DNS-22-053	1.75 2.50
R2	Res., ww, 1200 ohms ±3%, 2 w	DFS-12-030	.90
R18	Res., film, 2400 ohms ±5%, 1/2 w	DCS-24-001	.25
R24	Res., film, 180 ohms ±10%, 2 w	DCR-18-012	.20
R25A, B thru R29A, B	Res., tapped, two sections, 0.30 ohms ±5%/section 11 w/section	DFM-60-050	1.45
R40	Res., comp., 470 ohms ±10%, 2 w	DHB-4711	.15
R41*	Res., meter shunt, 30 amperes	ESP-30-001	2.50
T1	Transformer	ABA-FA10	101.50

*This part only used on units with "M" meter option

MODEL LM-FA12

C3	Cap., elect., 14,000 mfd -10 + 100%, 35 vdc	CBT-14-012	12.28
C18, C19	Same as C3		
C26 thru C29	Cap., paper, 1.0 mfd ±20%, 200 vdc	CAN-10-024	1.90
M1*	Meter, volts, D-C, 0-15 vdc full scale	EBP-15-017	18.00
M2*	Meter, amperes, D-C, 0-30 amp. movement	EDP-30-016	18.00
Q6	Transistor, NPN	FBN-36485	4.13
Q10 thru Q18	Transistor, NPN	FBN-36972	6.50
R1	Res., var., ww, 2,200 ohms ±5%, 5 w	DNS-22-023 or DNS-22-053	1.75 2.50
R2	Res., ww, 1800 ohms ±3%, 3 w	DFS-18-048	.60

UNIQUE PARTS (Cont)

MODEL LM-FA12 (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
R18	Res., film, 2400 ohms ±5%, 1/2 w	DCS-24-001	$ .25
R24	Res., film, 180 ohms ±10%, 2 w	DCR-18-012	.20
R25A, B thru R29A, B	Res., tapped, two sections, 0.30 ohms ±5%/section, 11 w/section	DFM-60-050	1.45
R40	Res., comp., 470 ohms ±10%, 2 w	DHB-4711	.15
R41*	Res., meter shunt, 30 amperes	ESP-30-001	2.50
T1	Transformer	ABA-F12	101.50

*This part only used on units with "M" meter option

MODEL LM-FA15

C3	Cap., elect., 14,000 mfd -10 + 100%, 35 vdc	CBT-14-012	12.28
C18, C19	Same as C3		
C26 thru C29	Cap., paper, 1.0 mfd ±20%, 200 vdc	CAN-10-024	1.90
M1*	Meter, volts, D-C, 0-20 vdc full scale	EBP-20-014	18.00
M2*	Meter, amperes, D-C, 0-20 amp. movement	EDP-20-019	18.00
Q6	Transistor, NPN	FBN-36220	6.60
Q10 thru Q18	Same as Q6		
R1	Res., var., ww, 2,200 ohms ±5%, 5 w	DNS-22-023 or DNS-22-053	1.75 2.50
R2	Res., ww, 1800 ohms ±3%, 3 w	DFS-18-048	.60
R18	Res., film, 2,400 ohms ±5%, 1/2 w	DCS-24-001	.25
R24	Res., film, 470 ohms ±10%, 2 w	DCR-47-013	.15
R25A, B thru R29A, B	Res., tapped, two sections, 0.47 ohms ±5%/section, 8 w/section	DFM-94-051	3.30
R40	Res., comp., 1000 ohms ±10%, 2 w	DHB-1021	.15
R41*	Res., meter shunt, 20 amperes	ESP-20-004	9.25
T1	Transformer	ABA-F15	101.50

*This part only used on units with "M" meter option

MODEL LM-FA18

C3	Cap., elect., 14,000 mfd -10 + 100%, 35 vdc	CBT-14-012	12.28
C18, C19	Same as C3		
C26 thru C29	Cap., paper, 1.0 mfd ±20%, 200 vdc	CAN-10-024	1.90
M1*	Meter, volts, D-C, 0-20 vdc full scale	EBP-20-014	18.00
M2*	Meter, amperes, D-C, 0-20 amp. movement	EDP-20-019	18.00
Q6	Transistor, NPN	FBN-36220	6.60
Q10 thru Q18	Same as Q6		
R1	Res., var., ww, 2,200 ohms ±5%, 5 w	DNS-22-023 or DNS-22-053	1.75 2.50

UNIQUE PARTS (Cont)

MODEL LM-FA18 (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
R2	Res., ww, 2500 ohms ±3%, 3 w	DFS-25-036	$ .53
R18	Res., film, 6,800 ohms ±5%, 1/2 w	DCS-68-021	.25
R24	Res., film, 470 ohms ±10%, 2 w	DCR-47-013	.15
R25A, B thru R29A, B	Res., tapped, two sections, 0.47 ohms ±5%/section 8 w/section	DFM-94-051	3.30
R40	Res., comp., 1000 ohms ±10%, 2 w	DHB-1021	.15
R41	Res., meter shunt, 20 amperes	ESP-20-004	9.25
T1	Transformer	ABA-F18	101.50

*This part only used on units with "M" meter option

MODEL LM-FA20

C3	Cap., elect., 14,000 mfd -10 + 100%, 35 vdc	CBT-14-012	12.28
C18, C19	Same as C3		
C26 thru C29	Cap., paper, 1.0 mfd ±20%, 200 vdc	CAN-10-024	1.90
M1*	Meter, volts, D-C, 0-25 vdc full scale	EBP-25-018	18.00
M2*	Meter, amperes, D-C, 0-20 amp. movement	EDP-20-019	18.00
Q6	Transistor, NPN	FBN-36220	6.60
Q10 thru Q18	Same as Q6		
R1	Res., var.,ww, 2,200 ohms ±5%, 5 w	DNS-22-023 or DNS-22-053	1.75 2.50
R2	Res., ww, 2500 ohms ±3%, 3 w	DFS-25-036	.53
R18	Res., film, 6800 ohms ±5%, 1/2 w	DCS-68-021	.25
R24	Res., film, 470 ohms ±10%, 2 w	DCR-47-013	.15
R25A, B thru R29A, B	Res., tapped, two sections, 0.47 ohms ±5%/section, 8 w/section	DFM-94-051	3.30
R40	Res., comp., 1,000 ohms ±10%, 2 w	DHB-1021	.15
R41	Res., meter shunt, 20 amperes	ESP-20-004	9.25
T1	Transformer	ABA-FA20	101.50

*This part only used on units with "M" meter option

MODEL LM-FA24

C3	Cap., elect., 7,800 mfd -10 + 100%, 60 vdc	CBS-78-045	8.18
C18, C19	Same as C3		
C26 thru C29	Cap., paper, 1.0 mfd ±20%, 200 vdc	CAN-10-024	1.90
M1*	Meter, volts, D-C, 0-40 vdc full scale	EBP-40-013	18.00
M2*	Meter, amperes, D-C, 0-15 amp. movement	EDP-15-014	18.00
Q6	Transistor, NPN	FBN-36220	6.60
Q10 thru Q18	Same as Q6		

UNIQUE PARTS (Cont)

MODEL LM-FA24 (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
R1	Res., var.,ww, 2,200 ohms ±5%, 5 w	DNS-22-023 or DNS-22-053	$1.75 2.50
R2	Res., ww, 3600 ohms ±3%, 3 w	DFS-36-050	.60
R18	Res., film, 6800 ohms ±5%, 1/2 w	DCS-68-021	.25
R24	Res., film, 1000 ohms ±10%, 2 w	DCS-10-029	.25
R25A, B thru R29A, B	Res., tapped, two sections, 0.75 ohms ±5%/section, 8 w/section	DFN-15-056	1.50
R40	Res., comp., 5600 ohms ±10%, 2 w	DHB-5621	.50
R41	Not assigned		
T1	Transformer	ABA-FA24	101.50

*This part only used on units with "M" meter option

MODEL LM-FA28

C3	Cap., elect., 7,800 mfd -10 + 100%, 60 vdc	CBS-78-045	8.18
C18, C19	Same as C3		
C26 thru C29	Cap., paper, 1.0 mfd ±20%, 200 vdc	CAN-10-024	1.90
M1*	Meter, volts, D-C, 0-40 vdc full scale	EBP-40-013	18.00
M2*	Meter, amperes, D-C, 0-15 amp. movement	EDP-15-014	18.00
Q6	Transistor, NPN	FBN-36220	6.60
Q10 thru Q18	Same as Q6		
R1	Res., var.,ww, 2,200 ohms ±5%, 5 w	DNS-22-023 or DNS-22-053	1.75 2.50
R2	Res., ww, 4500 ohms ±3%, 3 w	DFS-45-044	.87
R18	Res., film, 6,800 ohms ±5%, 1/2 w	DCS-68-021	.25
R24	Res., film, 1000 ohms ±10%, 2 w	DCS-10-029	.25
R25A, B thru R29A, B	Res., tapped, two sections, 0.75 ohms ±5%/section, 8 w/section	DFN-15-056	1.50
R40	Res., comp., 5,600 ohms ±10%, 2 w	DHB-5621	.50
R41	Not assigned		
T1	Transformer	ABA-F28	101.50

*This part only used on units with "M" meter option

MODEL LM-FA36

C3	Cap., elect., 7,800 mfd -10 + 100%, 60 vdc	CBS-78-045	8.18
C18, C19	Same as C3		
C26 thru C29	Cap., paper, 0.15 mfd ±20%, 400 vdc	CAM-15-015	1.60
M1*	Meter, volts, D-C, 0-40 vdc full scale	EBP-40-013	18.00
M2*	Meter, amperes, D-C, 0-15 amp. movement	EDP-15-014	18.00
Q6	Transistor, NPN	FBN-36487	5.63
Q10 thru Q18	Same as Q6		

MODEL LM-FA36 (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
R1	Res., var.,ww, 3,300 ohms ±5%, 5 w	DNS-33-035 or DNS-33-054	$ 2.00 2.50
R2	Res., ww, 5,600 ohms ±3%, 3 w	DFS-56-053	.60
R18	Res., film, 10,000 ohms ±5%, 1/2 w	DCT-10-008	.25
R24	Res., film, 1000 ohms ±10%, 2 w	DCS-10-029	.25
R25A, B thru R29A, B	Res., tapped, two sections, 0.75 ohms ±5%/section, 8 w/section	DFN-15-056	1.50
R40	Res., comp., 5600 ohms ±10%, 2 w	DHB-5621	.50
R41	Not assigned		
T1	Transformer	ABA-F36	101.50

*This part only used on units with "M" meter option

MODEL LM-FA48

C3	Cap., elect., 3,000 mfd -10 + 100%, 100 vdc	CBS-30-047	11.16
C18, C19	Same as C3		
C26 thru C29	Cap., paper, 0.15 mfd ±20%, 400 vdc	CAM-15-015	1.60
M1*	Meter, volts, D-C, 0-60 vdc full scale	EBP-60-015	18.00
M2*	Meter, amperes, D-C, 0-10 amp. movement	EDP-10-013	18.00
Q6	Transistor, NPN	FBN-36487	5.63
Q10 thru Q18	Same as Q6		
R1	Res.,var., ww,3,300 ohms ±5%, 5 w	DNS-33-035 or DNS-33-054	2.00 2.50
R2	Res., ww, 8,000 ohms ±3%, 3 w	DFS-80-054	1.03
R18	Res., film, 10,000 ohms ±5%, 1/2 w	DCT-10-008	.25
R24	Res., film, 1500 ohms ±10%, 2 w	DCS-15-030	.20
R25A, B thru R29A, B	Res., tapped, two sections, 1.5 ohms ±5%/section, 8 w/section	DFN-30-057	2.04
R40	Res., comp., 5,600 ohms ±10%, 2 w	DHB-5621	.50
R41	Not assigned		
T1	Transformer	ABA-F48	101.50

*This part only used on units with "M" meter option

MODELS LM-FA100 — LM-FA150

COMMON PARTS

C1	Cap., mylar, 0.033 mfd ±10%, 400 vdc	CGL-33-009	.38
C2	Cap., mylar, 0.15 mfd ±10%, 200 vdc	CGM-15-005	.40
C3	Cap., elect., 250 mfd -10 + 100%, 250 vdc	CBR-25-046	3.73
C4	Cap., elect., 3.5 mfd -10 + 100%, 300 vdc	CBN-35-018	1.12
C5	Cap., mylar, 0.018 mfd ±10%, 200 vdc	CGL-18-005	.24
C6	Cap., mylar, 0.001 mfd ±10%, 200 vdc	CGK-10-004	.21
C7*	Cap., elect., 140 mfd -10 + 100%, 30 vdc	CBR-14-030	2.25

COMMON PARTS (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
C8 thru C12	Not assigned		$
C13	Cap., mylar, 0.01 mfd ±10%, 200 vdc	CGL-10-002	.36
C14	Same as C13		
C15 thru C17	Not assigned		
C18	Cap., elect., 1,200 mfd -10 + 100%, 250 vdc	CBS-12-048	11.16
C19 thru C25	Not assigned		
C26 thru C29	Cap., paper, 0.15 mfd ±20%, 400 vdc	CAM-15-015	1.60
C30	Res., mylar, 0.022 mfd ± 10%, 200vdc	CGL-22-001	.39
C31	Same as C4		
CR1*	Rectifier, zener diode	FBM-Z104	4.35
CR2	Rectifier	FBL-00-030	1.40
CR3	Same as CR2		
CR4, CR5	Not assigned		
CR6	Rectifier, zener diode	FBM-Z103	4.87
CR7	Same as CR2		
CR8 thru CR11	Rectifier	FBL-00-067	2.00
CR12 thru CR17	Not assigned		
CR18	Rectifier	FBL-00-064	.75
CR19	Rectifier, zener diode	FBM-Z104	4.35
DS1	Pilot lamp	HRD-00-009	3.10
F1	Fuse, "Slo-Blo", 3 AG, 15 amp	FFC-15-000	.18
Q1	Transistor, NPN	FBN-L110	3.25
Q2	Same as Q1		
Q3	Same as Q1		
Q4	Not assigned		
Q5	Transistor, NPN	FBN-L108	2.52
Q6	Transistor, NPN	FBN-35903	5.17
Q7	Not assigned		
Q8	Same as Q5		
Q9	Same as Q6		
Q10	Transistor, NPN	FBN-35902	9.90
Q11	Not assigned		
Q12, Q13	Same as Q10		
Q14	Not assigned		
Q15, Q16	Same as Q10		
Q17	Not assigned		
Q18	Same as Q10		
R1	Res., var., ww, 9,000 ohms ±5%, 5 w	DNS-90-025 or DNS-90-051	2.00 2.50
R3	Res., ww, 1,200 ohms ±3%, 2 w	DFS-12-030	.90
R4*	Res., film, 15,000 ohms ±2%, 1/2 w	DCT-15-013	.30
R5	Res., film, 220 ohms ±2%, 1/2 w	DCR-22-005	.30
R6	Res., comp., 180,000 ohms ±10%, 1/2 w	DEB-1841	.12
R7	Res., film, 3,900 ohms ±5%, 1/2 w	DCS-39-014	.25
R8	Res., comp., 4,700 ohms ±10%, 1/2 w	DEB-4721	.12
R9	Res., comp., 150 ohms ±10%, 1/4 w	DCB-1511	.10

COMMON PARTS (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
R10	Res., comp., 3,900 ohms ±10%, 1/2 w	DEB-3921	$ .12
R11	Res., comp., 22,000 ohms ±10%, 1/2 w	DEB-2231	.12
R12	Res., comp., 47 ohms ±10%, 1/2 w	DEB-4701	.12
R13*	Res., ww, 600 ohms ±3%, 3 w	DFR-60-005	.89
R14, R15	Not assigned		
R16	Res., comp., 560 ohms ±10%, 1/2 w	DEB-5611	.12
R17	Res., var., ww, 1,200 ohms ±10%, 1-1/2 w	DNS-12-026	1.25
R19 thru R21	Not assigned		
R22	Res., comp., 220 ohms ±10%, 1/2 w	DEB-2211	.12
R23	Res., comp., 22 ohms ±10%, 1/2 w	DEB-2201	.12
R24	Res., film, 12,000 ohms ±10%, 2 w	DCT-12-022	.40
R25A thru R26B	Res., ww, tapped, 2 sections, 1.5 ohms ±5%/ section, 8 w/section	DFN-30-057	2.04
R27	Res., comp., 220 ohms ±10%, 1/2 w	DEB-2211	.12
R28A thru R29B	Same as R25		
R30 thru R35	Not assigned		
R36	Res., ww, 8,000 ohms ±3%, 3 w	DFS-80-054	1.03
R37	Same as R36		
R38	Same as R23		
R39	Res., comp., 2,200 ohms ±10%, 1/2 w	DEB-2221	.12
S1	Thermostat	FKA-118-012	5.00
S2+	Toggle switch, DPST	FDA-21-018	1.80
XF1	Fuseholder	HRM-00-002	.20

*This part not used on units with "Y" option
+This part not used on units with "OV" option

UNIQUE PARTS

MODEL LM-FA100

M1#	Meter, volts, D-C, 0-120 vdc full scale	EBR-12-075	18.00
M2#	Meter, amperes, D-C, 0-5 amp. movement	EDN-50-021	18.00
R2	Res., ww, 16,000 ohms ±3%, 5 w	DFT-16-039	.85
R18	Res., film, 39,000 ohms ±5%, 1/2 w	DCT-39-015	.30
T1	Transformer	ABA-FA100	101.50

#This part only used on units with "M" option

MODEL LM-FA120

M1#	Meter, volts, D-C, 0-150 vdc full scale	EBR-15-076	18.00
M2#	Meter, amperes, D-C, 0-3 amp. movement	EDN-30-019	18.00

MODEL LM-FA120 (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
R2	Res., ww, 20,000 ohms ±3%, 5 w	DFT-20-040	$ .80
R18	Res., film, 43,000 ohms ±5%, 1/2 w	DCT-43-016	.30
T1	Transformer	ABA-FA120	101.50

#This part only used on units with "M" option

MODEL LM-FA150

M1#	Meter, volts, D-C, 0-200 vdc full scale	EBR-20-077	18.00
M2#	Meter, amperes, D-C, 0-3 amp. movement	EDN-30-019	18.00
R2	Res., ww, 26,000 ohms ±3%, 5 w	DFT-26-041	1.20
R18	Res., film, 56,000 ohms ±5%, 1 w	DCT-56-017	.25
T1	Transformer	ABA-FA150	101.50

#This part only used on units with "M" option

PARTS FOR MODEL LM-FA60

C1	Cap., mylar, 0.033 mfd ±10%, 400 vdc	CGL-33-009	.38
C2	Cap., mylar, 0.22 mfd ±10%, 80 vdc	CGM-22-004	.90
C3	Cap., elect., 3,000 mfd -10 + 100%, 100 vdc	CBS-30-047	11.16
C4	Cap., elect., 3.5 mfd -10 + 100%, 300 vdc	CBN-35-018	1.12
C5	Cap., mylar, 0.018 mfd ±10%, 200 vdc	CGL-18-005	.24
C6	Same as C5		
C7*	Cap., elect., 140 mfd -10 + 100%, 30 vdc	CBR-14-030	2.25
C8 thru C17	Not assigned		
C18	Same as C3		
C19 thru C25	Not assigned		
C26 thru C29	Cap., paper, 0.15 mfd ±20%, 400 vdc	CAM-15-015	1.60
C30	Cap., mylar, 0.022 mfd ±10%, 200 vdc	CGL-22-001	.39
C31	Same as C4		
CR1*	Rectifier, zener diode	FBM-Z104	4.35
CR2	Rectifier	FBL-00-030	1.40
CR3	Same as CR2		
CR4, CR5	Not assigned		
CR6	Rectifier, zener diode	FBM-Z103	4.87
CR7	Same as CR2		
CR8 thru CR11	Rectifier	FBL-00-054	1.35
DS1	Pilot lamp	HRD-00-009	3.10
F1	Fuse, "Slo-Blo", 3 AG, 15 amp	FFC-15-000	.18
M1#	Meter, volts, D-C, 0-80 vdc full scale	EBP-80-019	18.00

PARTS FOR MODEL LM-FA60 (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
M2#	Meter, amperes, D-C, 0-6 amp. movement	EDN-60-018	$18.00
Q1	Transistor, NPN	FBN-L110	3.25
Q2	Same as Q1		
Q3	Same as Q1		
Q4	Not assigned		
Q5	Transistor, NPN	FBN-L108	2.52
Q6	Transistor, NPN	FBN-35902	9.90
Q7 thru Q10	Not assigned		
Q10 thru Q18	Same as Q6		
R1	Res., var., ww, 4,500 ohms ±5%, 5 w	DNS-45-024 or DNS-45-059	1.75 2.50
R2	Res., ww, 10,000 ohms ±3%, 5 w	DFT-10-042	.65
R3	Res., ww, 1,200 ohms ±3%, 2 w	DFS-12-030	.90
R4*	Res., film, 15,000 ohms ±2%, 1/2 w	DCT-15-013	.30
R5	Res., film, 220 ohms ±2%, 1/2 w	DCR-22-005	.30
R6	Res., comp., 180,000 ohms ±10%, 1/2 w	DEB-1841	.12
R7	Res., film, 3,900 ohms ±5%, 1/2 w	DCS-39-014	.25
R8	Res., comp., 4,700 ohms ±10%, 1/2 w	DEB-4721	.12
R9	Res., comp., 150 ohms ±10%, 1/4 w	DCB-1511	.10
R10	Res., comp., 3,900 ohms ±10%, 1/2 w	DEB-3921	.12
R11	Res., comp., 22,000 ohms ±10%. 1/2 w	DEB-2231	.12
R12	Res., comp., 47 ohms ±10%, 1/2 w	DEB-4701	.12
R13*	Res., ww, 600 ohms ±3%, 3 w	DFR-60-005	.89
R14, R15	Not assigned		
R16	Res., comp., 560 ohms ±10%, 1/2 w	DEB-5611	.12
R17	Res., var., ww, 1,200 ohms ±10%, 1-1/2 w	DNS-12-026	1.25
R18	Res., film, 15,000 ohms ±2%, 1/2 w	DCT-15-013	.30
R19 thru R21	Not assigned		
R22	Res., comp., 150 ohms ±10%, 1/2 w	DEB-1511	.12
R23	Res., comp., 15 ohms ±10%, 1/2 w	DEB-1501	.12
R24	Res., film, 5,600 ohms ±10%, 2 w	DCS-56-033	.20
R25A, B thru R29A, B	Res., ww, tapped, two sections, 1.5 ohms ±5%/section, 8 w/section	DFN-30-057	2.04
R30 thru R39	Not assigned		
R40	Res., comp., 10,000 ohms ±10%, 2 w	DHB-1031	.13
R41	Not assigned		
S1	Thermostat	FKA-118-012	5.00
S2+	Switch, toggle DPST	FDA-21-018	1.80
T1	Transformer	ABA-FA60	101.50
XF1	Fuseholder	HRM-00-002	.20

*This part not used on units with "Y" option
+This part not used on units with "OV" option
#This part only used on units with "M" option

PARTS FOR "OV" OPTION

MODELS LM-FA3 — LM-FA60

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
	The following parts are used only on LM-FA models with the "OV" option.		$
	LMOV-1 overvoltage subassembly used on models LM-FA3 thru LM-FA6 (see separate electrical parts list LMOV-1F for components located on this subassembly)	LMOV-1F	
	LMOV-2 overvoltage subassembly used on models LM-FA8 thru LM-FA15 (see separate electrical parts list LMOV-2F for components located on this subassembly)	LMOV-2F	
	LMOV-3 overvoltage subassembly used on models LM-FA18 thru LM-FA60 (see separate electrical parts list LMOV-3F for components located on this subassembly)	LMOV-3F	
C71	Cap., elect., 10 mfd -15% +75%, 75 vdc	CBP-10-018	1.80
CB1	Circuit breaker, magnetic	FHC-01-001-2	12.15
R71	Not used in models LM-FA3 thru LM-FA10		
R71	Res., ww, 2.0 ohms ±3%, 3 w (used in models LM-FA12 thru LM-FA24 only)	DFN-20-009	.60
R71	Res., ww, 5.0 ohms ±5%, 5 w (used in models LM-FA28 thru LM-FA36 only)	DFN-50-025	.61
R71	Res., ww, 10.0 ohms ±3%, 3 w (used in models LM-FA48 thru LM-FA60)	DFP-10-030	.60
R72	Res., comp., 3.3 ohms ±10%, 1/2 w	DEB 33G1	.12
R73	Res., ww, 1.0 ohm ±3%, 3 w	DFN-10-041	.66
SCR71	Rectifier, silicon, controlled	FBP-00-010	12.50

MODELS LMOV-1F, 2F, 3F

COMMON PARTS

C1	Cap., mylar, 0.01 mfd ±20%, 80 vdc	CGL-10-008	.25
Q1	Transistor, NPN	FBN-L102	2.40
R3	Res., film, 200 ohms ±5%, 1/2 w	DCR-20-010	.20
R4	Res., thermistor, 425 ohms ±5%, 1-1/4 w	DKR-43-001	1.52
R5	Res., comp., 1,200 ohms ±10%, 1/2 w	DEB-1221	.12
R6	Same as R5		
R8	Res., comp., 15,000 ohms ±10%, 1/2 w	DEB-1531	.12
R10	Same as R5		
SCR1	Rectifier, silicon, controlled	FBP-00-009	5.50

UNIQUE PARTS

MODEL LMOV - 1F

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
Q2	Transistor, PNP	FBN-L103	$ 1.76
R1	Res., var., ww, 2,000 ohms ±10%, 1 w	DNS-20-034	3.00
R2	Res., film, 560 ohms ±2%, 1/2 w	DCR-56-002	.65
R7	Res., comp., 33 ohms ±5%, 1/4 w	DCB-3305	.15
R9	Res., comp., 22 ohms ±10%, 1/2 w	DEB-2201	.12

MODEL LMOV-2F

Q2	Transistor, PNP	FBN-L103	1.76
R1	Res., var., ww, 5,000 ohms ±10%, 1 w	DNS-50-036	3.15
R2	Res., film, 1,470 ohms ±10%, 1/2 w	DCS-15-031	.30
R7	Res., comp., 33 ohms ±5%, 1/4 w	DCB-3305	.15
R9	Res., comp., 68 ohms ±10%, 1/2 w	DEB-6801	.12

MODEL LMOV-3F

Q2	Transistor, PNP	FBN-L114	3.50
R1	Res., var., ww, 20,000 ohms ±10%, 1 w	DNT-20-010	3.25
R2	Res., film, 4,700 ohms ±2%, 1/2 w	DCS-47-028	.30
R7	Res., comp., 39 ohms ±5%, 1/4 w	DCB-3905	.15
R9	Res., comp., 220 ohms ±10%, 1/2 w	DEB-2211	.12

PARTS FOR "Y" OPTION

C107	Cap., elect., 40 mfd, 35 vdc	CBP-40-014	1.68
CR1	Rect., zener diode	FBM-Z107	3.75
CR101	Rect., zener diode	FBM-Z104	$ 4.35
Q101	Transistor NPN	FBN-L109	2.75
R4	Res., comp., 220,000 ohms ±10%; 1/2 w	DEB-2241	.12
R101	Res., film, 6,800 ohms ±2%, 1/4 w	CCS-68-032	.30
R102	Res., film, 220 ohms ±2%, 1/4 w	DCR-22-014	.30

PARTS FOR "T" OPTION

All "FA" package models except F1 changes on LM-FA3 thru LM-FA6; LM-FA100, FA-120; LM-FA24 thru LM-FA48.

The following parts change and a resistor is added in series to DS-1:

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
C1	Cap., mylar, 0.033 mfd ±10%, 600 vdc	CGL-33-014	.35

PARTS FOR "T" OPTION (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
F1	Fuse, "SLO-BLO", 7.0 amps. 250V	FFG-07-000	.25
T1	Transformer	Add suffix "T" to reg. T1 no.	Same as reg. T1
DS1-Res.	Res., comp., 68K ±10%	DEB-6831	.12

On following models F1 has different value:

MODELS LM-FA3 thru LM-FA6; LM-FA100, LM-FA120

F1	Fuse, "SLO-BLO", 6.25 amp. 250V	FFG-06-250	.25

MODELS LM-FA24 thru LM-FA48

F1	Fuse, "SLO-BLO", 8.0 amps., 250V	FFG-08-000	.25

PARTS FOR "V" OPTION

All "FA" Package Models with the "V" Option have the same part changes as listed for the "T" Option except for transformer T1 listed below

T1	Transformer	Add suffix "V" to reg. T1 No.	Same as reg. T1

PARTS FOR "R" OPTION

Variable resistor R1 and transformer T1 change on all "FA" package models with suffix "R". Part no. changes for R1 are listed here. For transformer T1 used on these models see standard "FA" model parts lists for the standard transformer part no. and add suffix "R" to the part no. Price for T1 does not change.

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
	MODEL LM-FA3		
R1	Res, var., ww, 300 ohms ± 5%, 5 w	DNR-30-031	$6.25
	MODELS LM-FA3P3—LM-FA6		
R1	Res, var., ww, 1000 ohms ± 5%, 5 w	DNR-60-032	6.25
	MODEL LM-FA-8		
R1	Res, var., ww, 1000 ohms ± 5%, 5 w	DNS-10-069	6.25
	MODELS LM-FA10—LM-FA28, LMFA-0-7		
R1	Res, var., ww, 2200 ohms ± 5%, 5 w	DNS-22-070	6.25
	MODELS LM-FA36, LM-FA48		
R1	Res, var., ww, 3300 ohms ± 5%, 5 w	DNS-33-071	6.25
	MODEL LM-FA60		
R1	Res, var., ww, 4500 ohms ± 5%, 5 w	DNS-45-072	6.25
	MODELS LM-FA100—LM-FA150		
R1	Res, var., ww, 9000 ohms ± 5%, 5 w	DNS-90-073	6.25

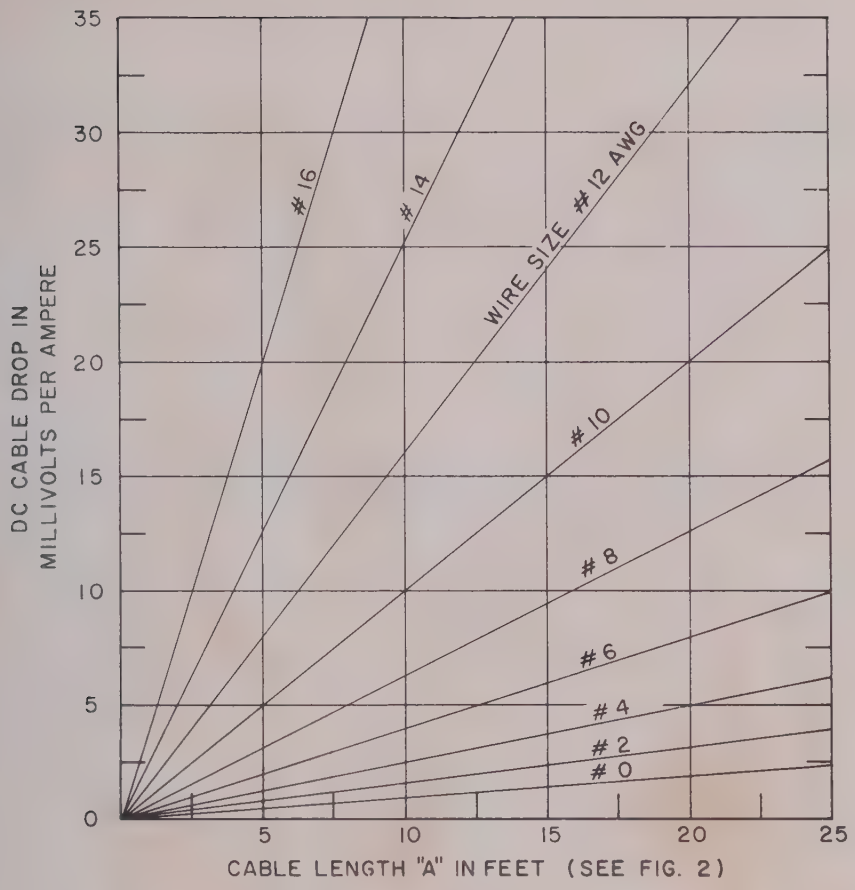


Figure 1. Cable Connection Chart

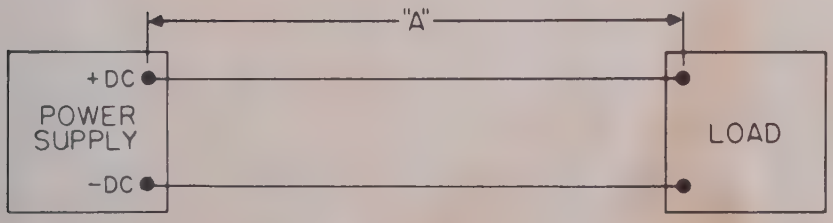
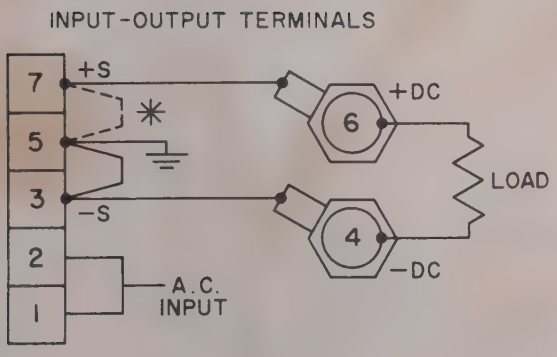
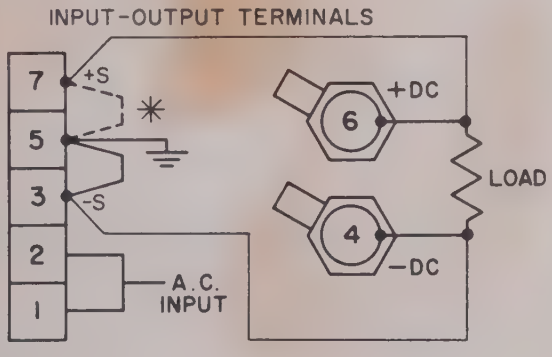


Figure 2. Cable Length "A" in Feet



NOTE:
✳ FOR POSITIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 3 AND 5 AND RECONNECT TO TERMINALS 5 AND 7.

Figure 3. Local Sensing Connections



NOTE:
✳ FOR POSITIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 3 AND 5 AND RECONNECT TO TERMINALS 5 AND 7.

Figure 4. Remote Sensing Connections

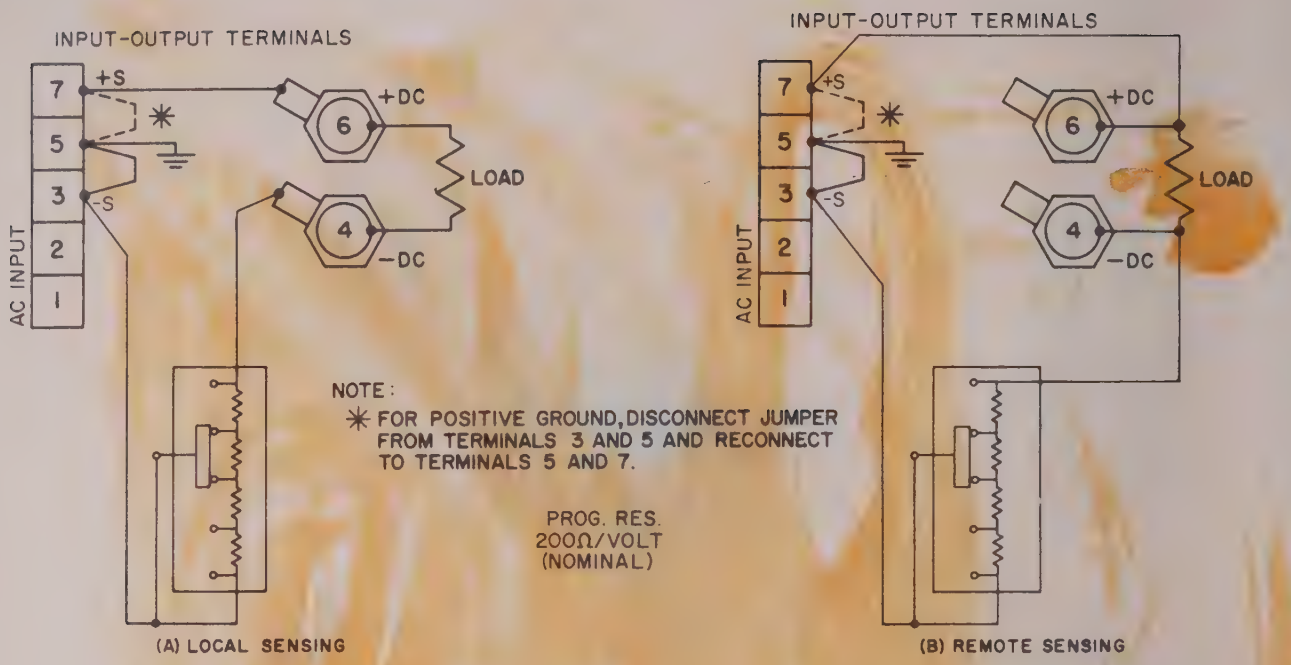


Figure 5. Programmed Voltage With External Resistor

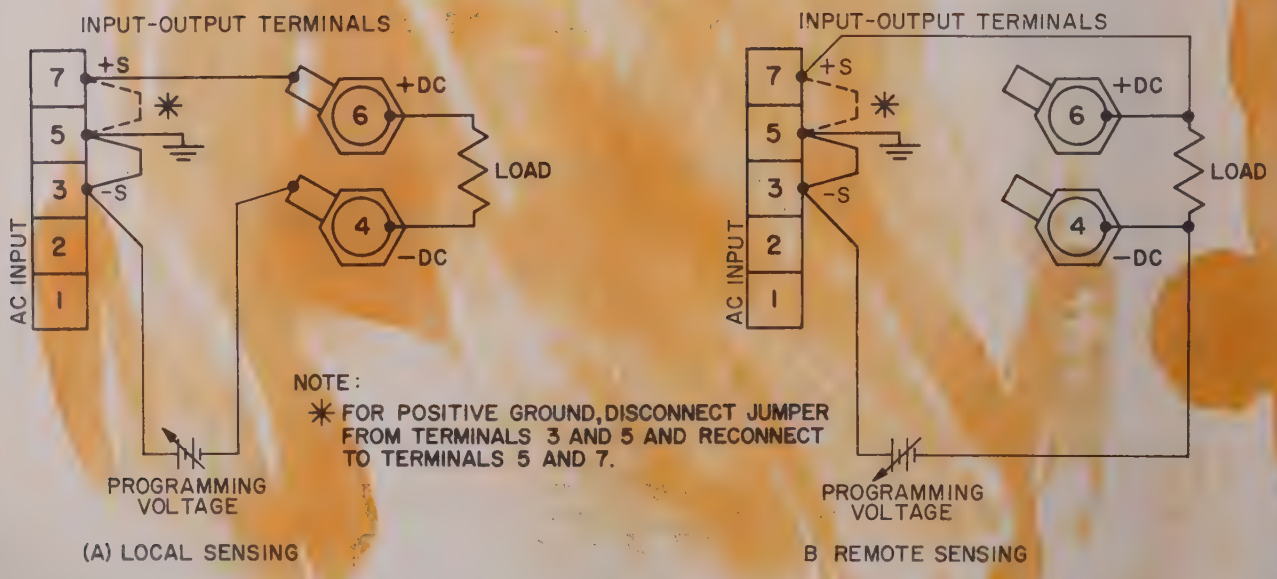


Figure 6. Programmed Voltage With External Programming Voltage Source

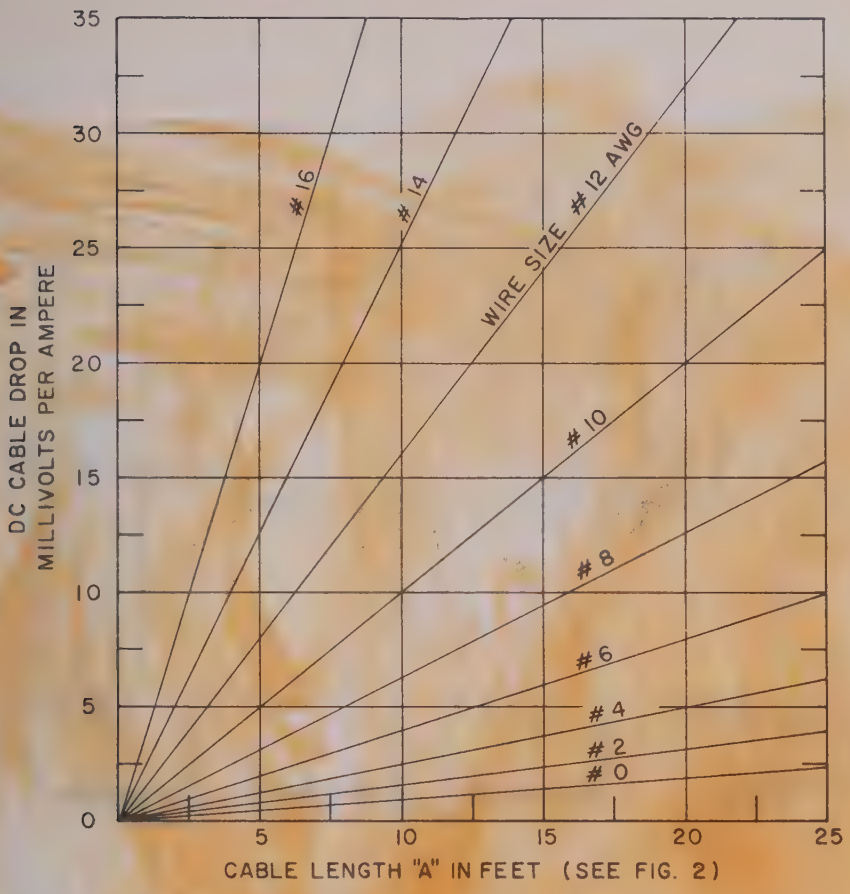


Figure 1. Cable Connection Chart

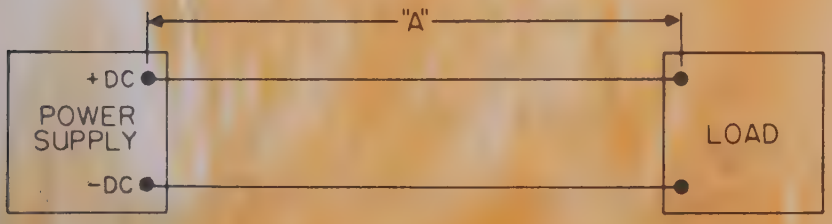
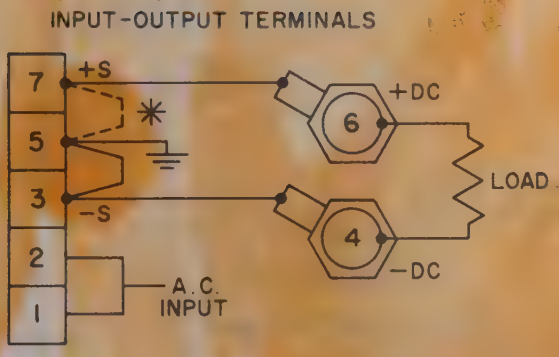
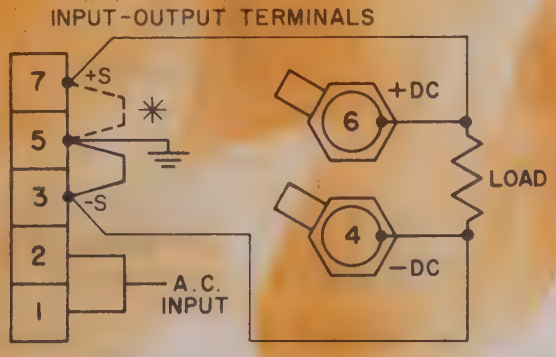


Figure 2. Cable Length "A" in Feet



NOTE:
✳ FOR POSITIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 3 AND 5 AND RECONNECT TO TERMINALS 5 AND 7.

Figure 3. Local Sensing Connections



NOTE:
✳ FOR POSITIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 3 AND 5 AND RECONNECT TO TERMINALS 5 AND 7.

Figure 4. Remote Sensing Connections

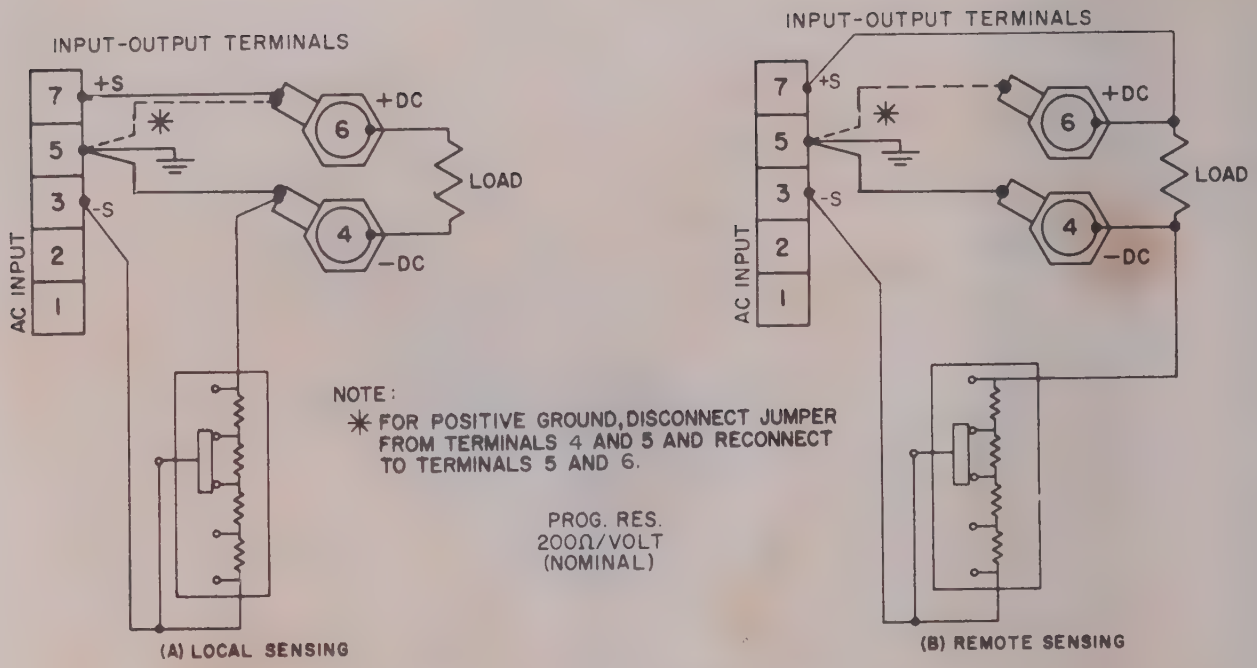


Figure 5. Programmed Voltage With External Resistor

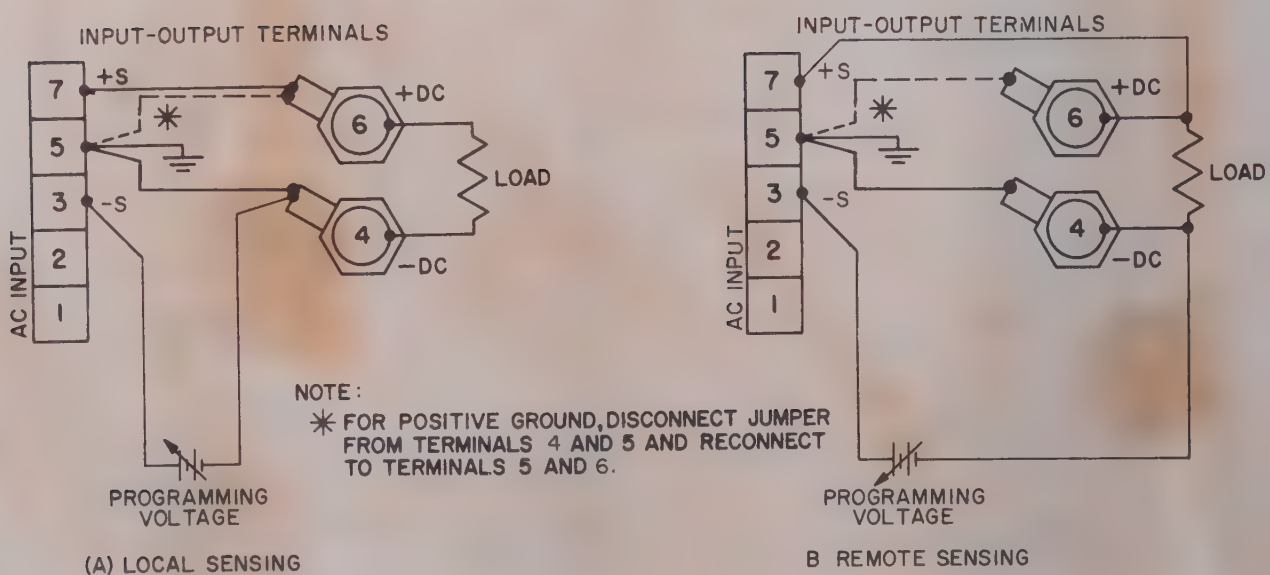


Figure 6. Programmed Voltage With External Programming Voltage Source

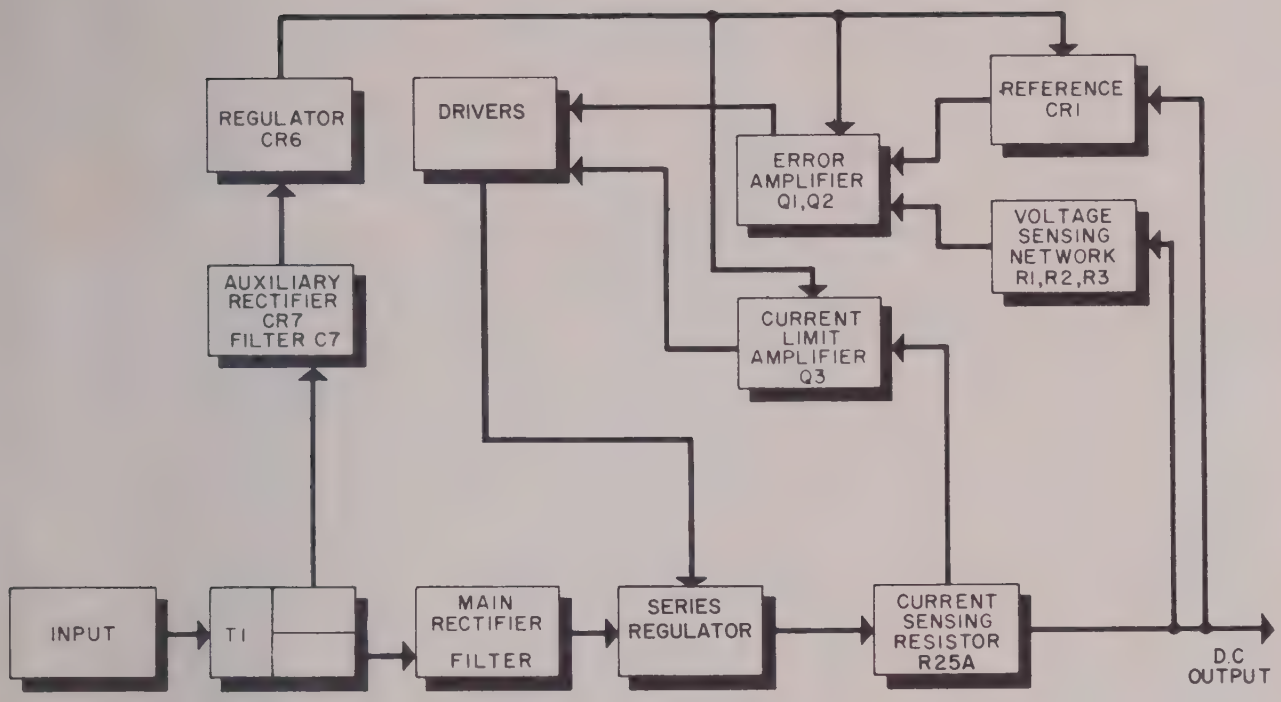
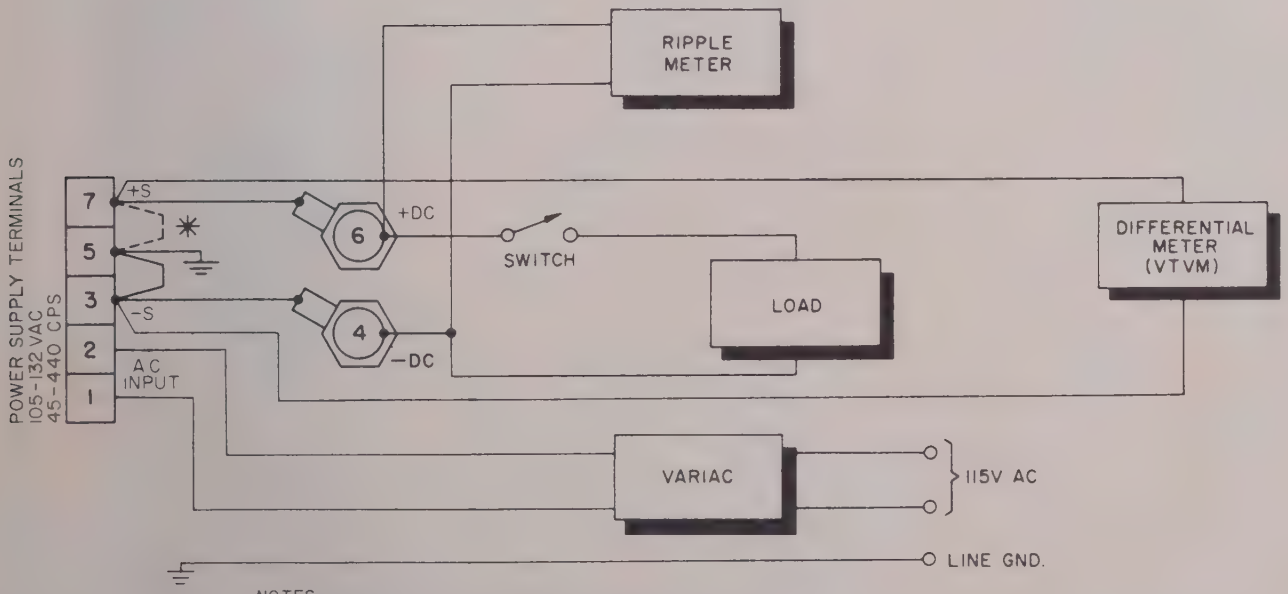


Figure 7. Typical Block Diagram

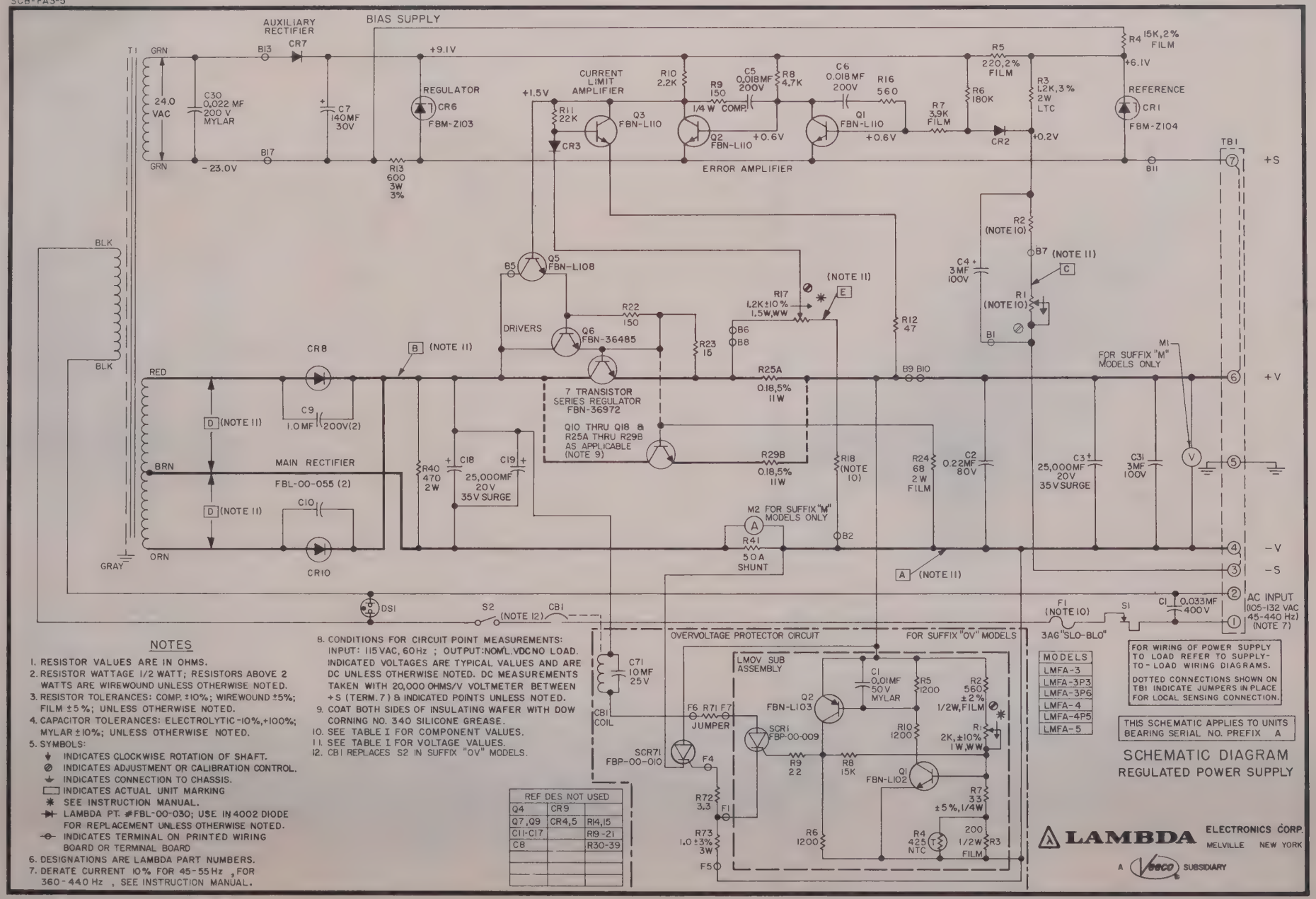


NOTES

1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE-WIRE CORD TO GROUND
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTIONS ONLY.
3. * FOR POSITIVE GROUND DISCONNECT JUMPER FROM TERMINALS 3 AND 5 AND RECONNECT TO TERMINALS 5 AND 7.

Figure 8. Test Connections for Performance Checks

SCB-FA3-5



NOTES

1. RESISTOR VALUES ARE IN OHMS.
2. RESISTOR WATTAGE 1/2 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±5%; FILM ±5%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%,+100%; MYLAR ±10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - INDICATES CONNECTION TO CHASSIS.
   - INDICATES ACTUAL UNIT MARKING
   - SEE INSTRUCTION MANUAL.
   - LAMBDA PT. #FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. DERATE CURRENT 10% FOR 45-55 Hz , FOR 360-440 Hz , SEE INSTRUCTION MANUAL.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60Hz ; OUTPUT: NOM'L. VDC NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 7) & INDICATED POINTS UNLESS NOTED.
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. SEE TABLE I FOR COMPONENT VALUES.
11. SEE TABLE I FOR VOLTAGE VALUES.
12. CBI REPLACES S2 IN SUFFIX "OV" MODELS.

REF DES NOT USED		
Q4	CR9	
Q7,Q9	CR4,5	R14,15
C11-C17		R19-21
C8		R30-39

MODELS
LMFA-3
LMFA-3P3
LMFA-3P6
LMFA-4
LMFA-4P5
LMFA-5

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN ON TBI INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

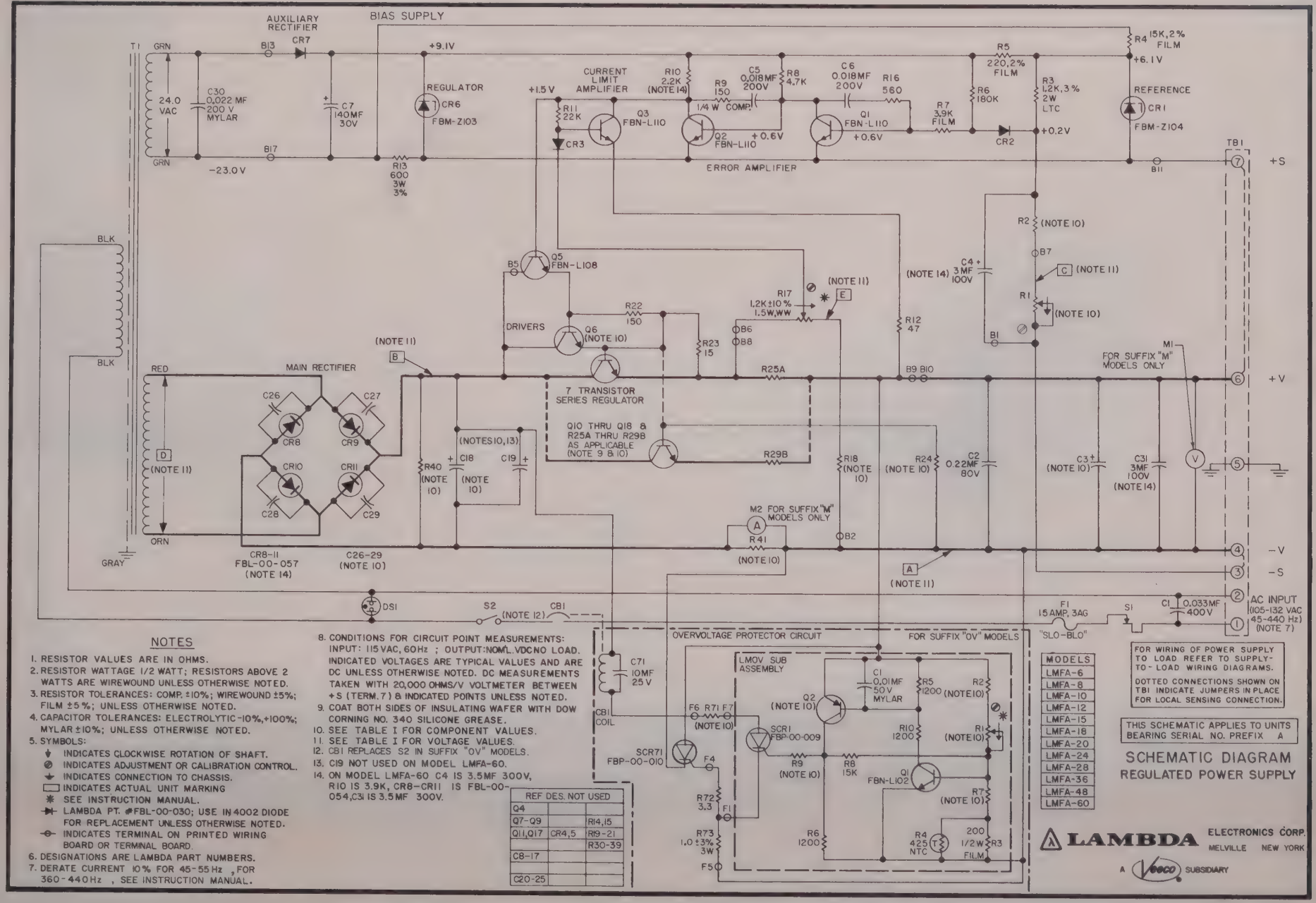
LAMBDA ELECTRONICS CORP.
MELVILLE NEW YORK
A Veeco SUBSIDIARY

TABLE I

DATA REFERENCES FOR MODELS LM-FA3–LM-FA5

Model	Voltage Range (VDC)	Max. Current (Amps)				Schematic Voltage Measurement					Schematic Components			
		40°C	50°C	60°C	71°C	A (VDC)	B (VDC)	C (VDC)	D (VAC)	E (VDC)	R1 5%, 5W	R2 3%, 3W	R18 5%, 1/2W	F1 (3AG)
LM-FA3	3±5%	31.5	28.5	24.0	18.0	-3.0	+11.6	-2.1	10.4	3.0	300	430	Jumper	10A
LM-FA3P3	3.3±5%	31.5	28.5	24.0	18.0	-3.3	+11.3	-2.1	10.4	3.3	600	430	Jumper	10A
LM-FA3P6	3.6±5%	31.5	28.5	24.0	18.0	-3.6	+11.0	-2.1	10.4	3.6	600	430	Jumper	10A
LM-FA4	4±5%	31.5	28.5	24.0	18.0	-4.0	+10.6	-3.0	10.4	4.0	600	600	Jumper	10A
LM-FA4P5	4.5±5%	31.5	28.5	24.0	18.0	-4.5	+11.5	-3.2	11.5	-3.4	600	650	390	15A
LM-FA5	5±5%	31.5	27.7	23.7	18.0	-5.0	+11.0	-3.2	11.5	-2.4	600	650	1300	15A

SCB-FA6-60



NOTES

1. RESISTOR VALUES ARE IN OHMS.
2. RESISTOR WATTAGE 1/2 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±5%; FILM ±5%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%,+100%; MYLAR ±10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - INDICATES CONNECTION TO CHASSIS.
   - INDICATES ACTUAL UNIT MARKING
   - SEE INSTRUCTION MANUAL.
   - LAMBDA PT. #FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. DERATE CURRENT 10% FOR 45-55 Hz , FOR 360-440 Hz , SEE INSTRUCTION MANUAL.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60Hz ; OUTPUT: NOML. VDC NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 7) & INDICATED POINTS UNLESS NOTED.
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. SEE TABLE I FOR COMPONENT VALUES.
11. SEE TABLE I FOR VOLTAGE VALUES.
12. CBI REPLACES S2 IN SUFFIX "OV" MODELS.
13. CI9 NOT USED ON MODEL LMFA-60.
14. ON MODEL LMFA-60 C4 IS 3.5MF 300V, R10 IS 3.9K, CR8-CR11 IS FBL-00-054, C3I IS 3.5MF 300V.

REF DES. NOT USED		
Q4		
Q7-Q9		R14,15
Q11,Q17	CR4,5	R19-21
		R30-39
C8-17		
C20-25		

MODELS
LMFA-6
LMFA-8
LMFA-10
LMFA-12
LMFA-15
LMFA-18
LMFA-20
LMFA-24
LMFA-28
LMFA-36
LMFA-48
LMFA-60

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN ON TBI INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A

SCHEMATIC DIAGRAM REGULATED POWER SUPPLY

LAMBDA ELECTRONICS CORP. MELVILLE NEW YORK

A Vesco SUBSIDIARY

TABLE I

DATA REFERENCES FOR MODELS LM-FA6—LM-FA60

Model	Voltage Range (VDC)	Max. Current (Amps)				Schematic Voltage Measurement					Schematic Components									
		40°C	50°C	60°C	71°C	A (VDC)	B (VDC)	C (VDC)	D (VAC)	E (VDC)	C3,C18,C19*	C26-C29	Q6 (FBN-)	Q-10 – Q-18 (FBN)	R1 5%, 5W	R2 3%, 3W	R18 5%,1/2W	R25A,B—R29A,B Value/Section	R24 10%, 2W	R40 10%, 2W
LM-FA6	6±5%	30.5	26.0	22.0	18.0	-6.0	+12.6	-4.0	13.0	-2.9	25000MF, 20V 35V SURGE	1.0MF ±20% 200V	36485	36972	600	800	1300	0.18±5%, 11W	180	470
LM-FA8	8±5%	28.3	23.9	20.0	16.9	-8.0	+14.0	-6.0	15.5	-2.7	25000MF, 20V 35V SURGE	1.0MF ±20% 200V	36485	36972	1000	1200	2400	0.30±5%, 11W	180	470
LM-FA10	10±5%	25.0	21.0	18.9	15.7	-10.0	+16.0	-6.0	18.0	-3.3	14000MF, 35V 60V SURGE	1.0MF ±20% 200V	36485	36972	2200	1200	2400	0.30±5%, 11W	180	470
LM-FA12	12±5%	22.0	19.0	16.2	13.2	-12.0	+16.0	-9.0	20.0	-4.0	14000MF, 35V 60V SURGE	1.0MF ±20% 200V	36485	36972	2200	1800	2400	0.30±5%, 11W	180	470
LM-FA15	15±5%	19.4	18.3	15.2	12.6	-15.0	+17.0	-9.0	22.7	-5.0	14000MF, 35V 60V SURGE	1.0MF ±20% 200V	36220	36220	2200	1800	2400	0.47±5%, 8W	470	1000
LM-FA18	18±5%	17.7	16.2	13.6	11.5	-18.0	+17.0	-12.5	25.0	-2.7	14000MF, 35V 60V SURGE	1.0MF ±20% 200V	36220	36220	2200	2500	6800	0.47±5%, 8W	470	1000
LM-FA20	20±5%	16.0	14.7	12.6	10.5	-20.0	+20.0	-12.5	28.5	-3.0	14000MF, 35V 60V SURGE	1.0MF ±20% 200V	36220	36220	2200	2500	6800	0.47±5%, 8W	470	1000
LM-FA24	24±5%	14.0	13.0	11.4	9.0	-24.0	+18.5	-18.0	30.5	-3.6	7800MF, 60V 100V SURGE	1.0MF ±20% 200V	36220	36220	2200	3600	6800	0.75±5%, 8W	1000	5600
LM-FA28	28±5%	13.5	12.0	10.4	8.5	-28.0	+22.0	-22.5	36.0	-4.2	7800MF, 60V 100V SURGE	1.0MF ±20% 200V	36220	36220	2200	4500	6800	0.75±5%, 8W	1000	5600
LM-FA36	36±5%	11.0	10.0	8.8	7.3	-36.0	+24.0	-28.0	43.0	-3.9	7800MF, 60V 100V SURGE	0.15MF ±20% 200V	36487	36487	3300	5600	10000	0.75±5%, 8W	1000	5600
LM-FA48	48±5%	8.1	7.5	6.5	5.4	-48.0	+30.0	-40.0	56.5	-5.2	3000MF, 100V 150V SURGE	0.15MF ±20% 200V	36487	36487	3300	8000	10000	1.50±5%, 8W	1500	5600
LM-FA60	60±5%	5.8	5.3	4.7	3.6	-60.0	+29.0	-50.0	71.0	-4.4	3000MF, 100V 150V SURGE	0.15MF ±20% 200V	35902	35902	4500	10000	15000	1.50±5%, 8W	5600	10000

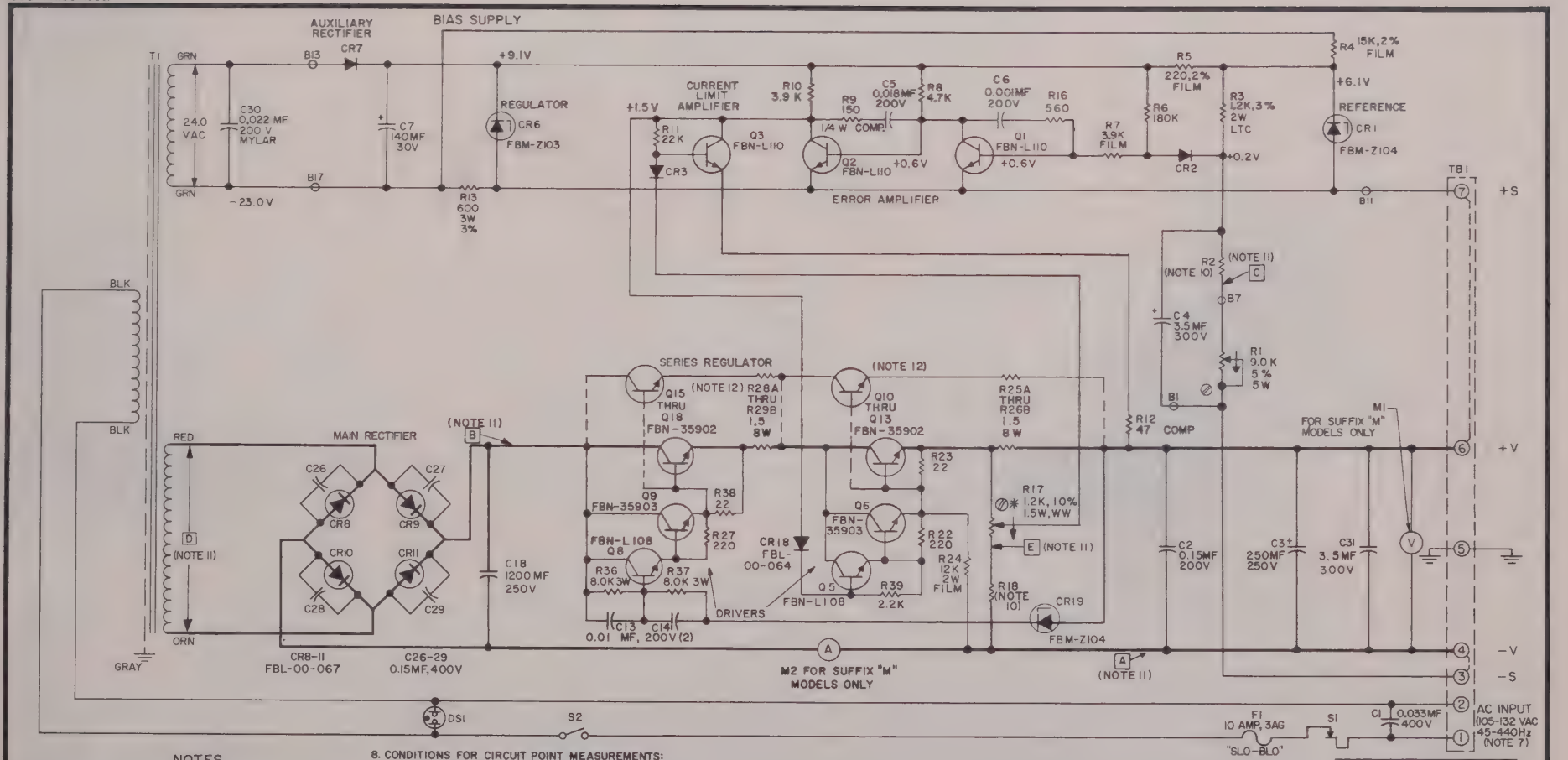
*C19 Not used on LM-FA60

TABLE I (CONT'D)

DATA REFERENCES FOR MODEL LM-FA6 – LM-FA60

Model	Schematic Components (Cont'd)							
	R41 Meter Shunt	R71	L MOV Subassembly					
			Q2	R1 ±10%, 1W	R2	R7 ±5%, 1/4W	R9 ±10%, 1/2W
LM-FA6	50A	Jumper	FBN-L103	2000	560 ±2%, 1/2W	33	22
LM-FA8	30A	Jumper	FBN-L103	5000	1470 ±1%, 1/2W	33	68
LM-FA10	30A	Jumper	FBN-L103	5000	1470 ±1%, 1 2W	33	68
LM-FA12	30A	2.0,±3% 3W	FBN-L103	5000	1470 ±1%, 1 2W	33	68
LM-FA15	20A	2.0,±3% 3W	FBN-L103	5000	1470 ±1%, 1/2W	33	68
LM-FA18	20A	2.0,±3% 3W	FBN-L114	20000	4700 ±2%, 1/2W	39	220
LM-FA20	20A	2.0,±3% 3W	FBN-L114	20000	4700 ±2%, 1/2W	39	220
LM-FA24	NOT USED	2.0,±3% 3W	FBN-L114	20000	4700 ±2%, 1/2W	39	220
LM-FA28	NOT USED	5.0,±5%	FBN-L114	20000	4700 ±2%, 1/2W	39	220
LM-FA36	NOT USED	5.0,±5%	FBN-L114	20000	4700 ±2%, 1/2W	39	220
LM-FA48	NOT USED	10.0,±5%	FBN-L114	20000	4700 ±2%, 1 2W	39	220
LM-FA60	NOT USED	10.0,±5%	FBN-L114	20000	4700 ±2%, 1 2W	39	220

SCB-FA100-150A



NOTES

1. RESISTOR VALUES ARE IN OHMS.
2. RESISTOR WATTAGE 1/2 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±5%; FILM ±5%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%,+100%; MYLAR ±10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - INDICATES CONNECTION TO CHASSIS.
   - INDICATES ACTUAL UNIT MARKING
   - SEE INSTRUCTION MANUAL.
   - LAMBDA PT. #FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. DERATE CURRENT 10% FOR 45-55 Hz , FOR 360-440 Hz , SEE INSTRUCTION MANUAL.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60Hz, OUTPUT: NOM'L. VDC NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISF NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 7) & INDICATED POINTS UNLESS NOTED.
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. SEE TABLE I FOR COMPONENT VALUES.
11. SEE TABLE I FOR VOLTAGE VALUES.
12. Q17 AND Q11 NOT USED.

REF. DES. NOT USED		
Q4, Q7		
Q17, Q11		R14, 15
Q14	CR4, 5	R19-21
C15-C17	CR12-17	R30-35
C8-12		
C19-C25		

MODELS
LMFA-100
LMFA-120
LMFA-150

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

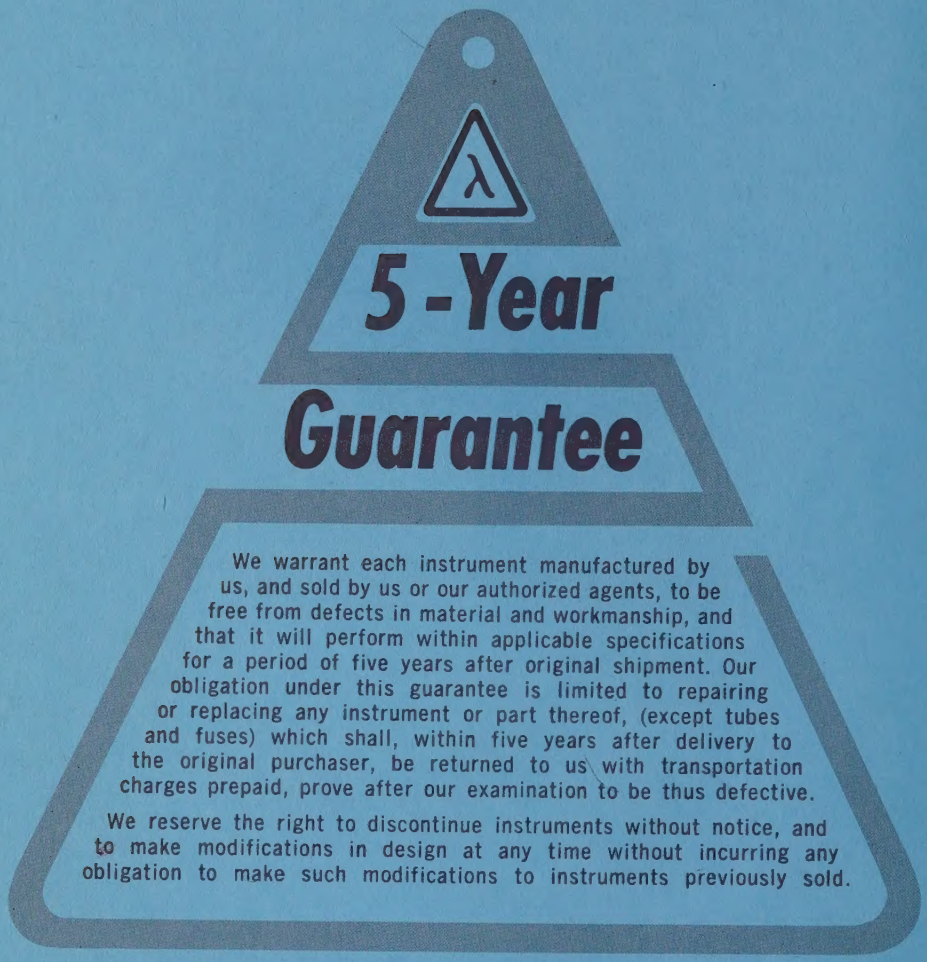
LAMBDA ELECTRONICS CORP. MELVILLE NEW YORK

A Vaco SUBSIDIARY

TABLE I

DATA REFERENCES FOR MODELS LM-FA100, LM-FA120, LM-FA150

Model	Voltage Range (VDC)	Max. Current (Amps)				Schematic Voltage Measurement					Schematic Components	
		40°C	50°C	60°C	71°C	A (VDC)	B (VDC)	C (VDC)	D (VAC)	E (VDC)	R2 ±3%, 5W	R18 ±5%, 1/2W
LM-FA100	100±5%	3.1	2.7	2.3	1.9	-100	+60	-80	114	-3	16,000	39,000
LM-FA120	120±5%	2.8	2.4	2.1	1.7	-120	+70	-100	132	-3	20,000	43,000
LM-FA150	150±5%	2.4	2.1	1.8	1.4	-150	+75	-130	162	-3	26,000	56,000


5-Year
Guarantee
We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.
We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

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